

BID OF \_\_\_\_\_

**2014**

**PROPOSAL, CONTRACT, BOND AND SPECIFICATIONS**

**FOR**

**HIGHLAND MANOR STORM SHELTER (BUILDING COMPONENT)**

**CONTRACT NO. 7343**

**PROJECT NO. 53W1625  
IN**

**MADISON, DANE COUNTY, WISCONSIN**

AWARDED BY THE COMMON COUNCIL  
MADISON, WISCONSIN ON \_\_\_\_\_

CITY ENGINEERING DIVISION  
1600 EMIL STREET  
MADISON, WISCONSIN 53713

<https://bidexpress.com/login>

**HIGHLAND MANOR STORM SHELTER (BUILDING COMPONENT)  
CONTRACT NO. 7343**

**INDEX**

|   |     |
|---|-----|
| SECTION A: ADVERTISEMENT FOR BIDS AND INSTRUCTIONS TO BIDDERS ..... | A-1 |
| SECTION B: PROPOSAL SECTION .....                                   | B-1 |
| SECTION C: SMALL BUSINESS ENTERPRISE .....                          | C-1 |
| SECTION D: SPECIAL PROVISIONS .....                                 | D-1 |
| SECTION E: BIDDER'S ACKNOWLEDGEMENT .....                           | E-1 |
| SECTION F: DISCLOSURE OF OWNERSHIP & BEST VALUE CONTRACTING .....   | F-1 |
| SECTION G: BID BOND .....   | G-1 |
| SECTION H: AGREEMENT .....  | H-1 |
| SECTION I: PAYMENT AND PERFORMANCE BOND .....                       | I-1 |
| SECTION J: PREVAILING WAGE RATES .....                              | J-1 |

This Proposal, and Agreement have  
been prepared by:

**CITY ENGINEERING DIVISION  
CITY OF MADISON  
MADISON, DANE COUNTY, WISCONSIN**

A handwritten signature in black ink, appearing to read "Robert Phillips", is written over a horizontal line.

Robert F. Phillips, P.E., City Engineer

RFP: kf

## SECTION A: ADVERTISEMENT FOR BIDS AND INSTRUCTIONS TO BIDDERS

### REQUEST FOR BID FOR PUBLIC WORKS CONSTRUCTION CITY OF MADISON, WISCONSIN

#### A BEST VALUE CONTRACTING MUNICIPALITY

|  |  |
|--|--|
| PROJECT NAME:                                | HIGHLAND MANOR STORM SHELTER<br>(BUILDING COMPONENT) |
| CONTRACT NO.:                                | 7343   |
| SBE GOAL                                     | 11%  |
| BID BOND                                     | 5%   |
| PRE BID MEETING (1:00 P.M.)                  | JUNE 20, 2014  |
| PREQUALIFICATION APPLICATION DUE (1:00 P.M.) | JUNE 25, 2014  |
| BID SUBMISSION (1:00 P.M.)                   | JULY 2, 2014   |
| BID OPEN (1:30 P.M.)                         | JULY 2, 2014   |
| PUBLISHED IN WSJ                             | 6/13/14, 6/20/14 & 6/27/14                           |

PRE BID MEETING: Representatives of the Affirmative Action Department will be present to discuss the Small Business Enterprise requirements at 1600 Emil Street, Madison Wisconsin.

PREQUALIFICATION APPLICATION: Forms are available on our website, [www.cityofmadison.com/business/pw/forms.cfm](http://www.cityofmadison.com/business/pw/forms.cfm). If not currently prequalified in the categories listed in Section A, an amendment to your Prequalification will need to be submitted prior to the same due date. Postmark is not applicable.

BIDS TO BE SUBMITTED by hand to 1600 EMIL ST., MADISON, WI 53713 or online at [www.bidexpress.com](http://www.bidexpress.com).

THE BID OPENING is at 1600 EMIL ST., MADISON, WI 53713.

#### STANDARD SPECIFICATIONS

The City of Madison's Standard Specifications for Public Works Construction - 2014 Edition, as supplemented and amended from time to time, forms a part of these contract documents as if attached hereto.

These standard specifications are available on the City of Madison Public Works website, [www.cityofmadison.com/Business/PW/specs.cfm](http://www.cityofmadison.com/Business/PW/specs.cfm).

The Contractor shall review these Specifications prior to preparation of proposals for the work to be done under this contract, with specific attention to Article 102, "BIDDING REQUIREMENTS AND CONDITIONS" and Article 103, "AWARD AND EXECUTION OF THE CONTRACT." For the convenience of the bidder, below are highlights of three subsections of the specifications.

#### SECTION 102.1: PRE-QUALIFICATION OF BIDDERS

In accordance with Wisconsin State Statutes 66.0901 (2) and (3), all bidders must submit to the Board of Public Works proof of responsibility on forms furnished by the City. The City requires that all bidders be qualified on a biennial basis.

Bidders must present satisfactory evidence that they have been regularly engaged in the type of work specified herein and they are fully prepared with necessary capital, materials, machinery and supervisory personnel to conduct the work to be contracted for to the satisfaction of the City. All bidders must be pre-

qualified by the Board of Public Works for the type of construction on which they are bidding prior to the opening of the bid.

In accordance with Section 39.02(9)(a)l. of the General Ordinances, all bidders shall submit in writing to the Affirmative Action Division Manager of the City of Madison, a Certificate of Compliance or an Affirmative Action Plan at the same time or prior to the submission of the proof of responsibility forms.

The bidder shall be disqualified if the bidder fails to or refuses to, prior to opening of the bid, submit a Certificate of compliance, Affirmative Action Plan or Affirmative Action Data Update, as applicable, as defined by Section 39.02 of the General Ordinances (entitled Affirmative Action) and as required by Section 102.11 of the Standard Specifications.

#### SECTION 102.4 PROPOSAL

No bid will be accepted that does not contain an adequate or reasonable price for each and every item named in the Schedule of Unit Prices.

A lump sum bid for the work in accordance with the plans and specifications is required. The lump sum bid must be the same as the total amounts bid for the various items and it shall be inserted in the space provided.

All papers bound with or attached to the proposal form are considered a part thereof and must not be detached or altered when the proposal is submitted. The plans, specifications and other documents designated in the proposal form will be considered a part of the proposal whether attached or not.

A proposal submitted by an individual shall be signed by the bidder or by a duly authorized agent. A proposal submitted by a partnership shall be signed by a member/partner or by a duly authorized agent thereof. A proposal submitted by a corporation shall be signed by an authorized officer or duly authorized registered agent of such corporation, and the proposal shall show the name of the State under the laws of which such corporation was chartered. The required signatures shall in all cases appear in the space provided thereof on the proposal.

Each proposal shall be placed, together with the proposal guaranty, in a sealed envelope, so marked as to indicate name of project, the contract number or option to which it applies, and the name and address of the Contractor or submitted electronically through Bid Express ([www.bidexpress.com](http://www.bidexpress.com)). Proposals will be accepted at the location, the time and the date designated in the advertisement. Proposals received after the time and date designated will be returned to the bidder unopened.

The Bidder shall execute the Disclosure of Ownership form. REFER TO SECTION F.

#### SECTION 102.5: BID DEPOSIT (PROPOSAL GUARANTY)

All bids, sealed or electronic, must be accompanied with a Bid Bond equal to at least 5% of the bid or a Certificate of Annual/Biennial Bid Bond or certified check, payable to the City Treasurer. Bid deposit of the successful bidders shall be returned within forty-eight (48) hours following execution of the contract and bond as required.

#### PREVAILING WAGE RATES

Prevailing Wage Rates may be required and are attached in Section J of the contract. See Special Provisions to determine applicability.

**Bidders for this Contract(s) must be Pre-Qualified for at least one of the following type(s) of construction denoted by an ☒**

**Building Demolition**

- 101 ☐ Asbestos Removal  
120 ☐ House Mover

- 110 ☐ Building Demolition

**Street, Utility and Site Construction**

- 201 ☐ Asphalt Paving  
205 ☐ Blasting  
210 ☐ Boring/Pipe Jacking  
215 ☐ Concrete Paving  
220 ☐ Con. Sidewalk/Curb & Gutter/Misc. Flat Work  
221 ☐ Concrete Bases and Other Concrete Work  
222 ☐ Concrete Removal  
225 ☐ Dredging  
230 ☐ Fencing  
235 ☐ Fiber Optic Cable/Conduit Installation  
240 ☐ Grading and Earthwork  
241 ☐ Horizontal Saw Cutting of Sidewalk  
242 ☐ Infrared Seamless Patching  
245 ☐ Landscaping, Maintenance  
250 ☐ Landscaping, Site and Street  
251 ☐ Parking Ramp Maintenance  
252 ☐ Pavement Marking  
255 ☐ Pavement Sealcoating and Crack Sealing  
260 ☐ Petroleum Above/Below Ground Storage Tank Removal/Installation  
262 ☐ Playground Installer  
265 ☐ Retaining Walls, Precast Modular Units

- 270 ☐ Retaining Walls, Reinforced Concrete  
275 ☐ Sanitary, Storm Sewer and Water Main Construction  
276 ☐ Sawcutting  
280 ☐ Sewer Lateral Drain Cleaning/Internal TV Insp.  
285 ☐ Sewer Lining  
290 ☐ Sewer Pipe Bursting  
295 ☐ Soil Borings  
300 ☐ Soil Nailing  
305 ☐ Storm & Sanitary Sewer Laterals & Water Svc.  
310 ☐ Street Construction  
315 ☐ Street Lighting  
318 ☐ Tennis Court Resurfacing  
320 ☐ Traffic Signals  
325 ☐ Traffic Signing & Marking  
332 ☐ Tree pruning/removal  
333 ☐ Tree, pesticide treatment of  
335 ☐ Trucking  
340 ☐ Utility Transmission Lines including Natural Gas, Electrical & Communications  
399 ☐ Other \_\_\_\_\_

**Bridge Construction**

- 501 ☐ Bridge Construction and/or Repair

**Building Construction**

- 401 ☐ Floor Covering (including carpet, ceramic tile installation, rubber, VCT)  
402 ☐ Building Automation Systems  
403 ☐ Concrete  
404 ☐ Doors and Windows  
405 ☐ Electrical - Power, Lighting & Communications  
410 ☐ Elevator - Lifts  
412 ☐ Fire Suppression  
413 ☐ Furnishings - Furniture and Window Treatments  
415 ☐ General Building Construction, Equal or Less than \$250,000  
420 ☒ General Building Construction, \$250,000 to \$1,500,000  
425 ☒ General Building Construction, Over \$1,500,000  
428 ☐ Glass and/or Glazing  
429 ☐ Hazardous Material Removal  
430 ☐ Heating, Ventilating and Air Conditioning (HVAC)  
433 ☐ Insulation - Thermal  
435 ☐ Masonry/Tuck pointing

- 437 ☐ Metals  
440 ☐ Painting and Wallcovering  
445 ☐ Plumbing  
450 ☐ Pump Repair  
455 ☐ Pump Systems  
460 ☐ Roofing and Moisture Protection  
464 ☐ Tower Crane Operator  
461 ☐ Solar Photovoltaic/Hot Water Systems  
465 ☐ Soil/Groundwater Remediation  
466 ☐ Warning Sirens  
470 ☐ Water Supply Elevated Tanks  
475 ☐ Water Supply Wells  
480 ☐ Wood, Plastics & Composites - Structural & Architectural  
499 ☐ Other \_\_\_\_\_

**State of Wisconsin Certifications**

- 1 ☐ Class 5 Blaster - Blasting Operations and Activities 2500 feet and closer to inhabited buildings for quarries, open pits and road cuts.  
2 ☐ Class 6 Blaster - Blasting Operations and Activities 2500 feet and closer to inhabited buildings for trenches, site excavations, basements, underwater demolition, underground excavations, or structures 15 feet or less in height.  
3 ☐ Class 7 Blaster - Blasting Operations and Activities for structures greater than 15' in height, bridges, towers, and any of the objects or purposes listed as "Class 5 Blaster or Class 6 Blaster".  
4 ☐ Petroleum Above/Below Ground Storage Tank Removal and Installation (Attach copies of State Certifications.)  
5 ☐ Hazardous Material Removal (Contractor to be certified for asbestos and lead abatement per the Wisconsin Department of Health Services, Asbestos and Lead Section (A&LS).) See the following link for application:  
[www.dhs.wisconsin.gov/Asbestos/Cert](http://www.dhs.wisconsin.gov/Asbestos/Cert). State of Wisconsin Performance of Asbestos Abatement Certificate must be attached.  
6 ☐ Certification number as a Certified Arborist or Certified Tree Worker as administered by the International Society of Arboriculture  
7 ☐ Pesticide application (Certification for Commercial Applicator For Hire with the certification in the category of turf and landscape (3.0) and possess a current license issued by the DATCP)  
8 ☐ State of Wisconsin Master Plumbers License.

## SECTION B: PROPOSAL

Please refer to the  
Bid Express Website  
at <https://bidexpress.com>  
look up contract number  
and go to  
Section B: Proposal Page

You can access all City of Madison bid solicitations for FREE at [www.bidexpress.com](http://www.bidexpress.com)

Click on the "Register for Free" button and follow the instructions to register your company and yourself. You will be asked for a payment subscription preference, since you may wish to bid online someday. Simply choose the method to pay on a 'per bid' basis. This requires no payment until / unless you actually bid online. You can also choose the monthly subscription plan at this time. You will, however, be asked to provide payment information. Remember, you can change your preference at anytime. You will then be able to complete your free registration and have full access to the site. Your free access does not require completion of the 'Digital ID' process, so you will have instant access for viewing and downloading. To be prepared in case you ever do wish to bid online, you may wish to establish your digital ID also, since you cannot bid without a Digital ID.

If you have any problems with the free registration process, you can call the bidexpress help team, toll free at 1-888-352-2439 (option 1, option1).

## **SECTION C: SMALL BUSINESS ENTERPRISE**

### **Instructions to Bidders City of Madison SBE Program Information**

#### **2 Small Business Enterprise (SBE) Program Information**

##### **2.1 Policy and Goal**

The City of Madison reaffirms its policy of nondiscrimination in the conduct of City business by maintaining a procurement process which remains open to all who have the potential and ability to sell goods and services to the City. It is the policy of the City of Madison to allow Small Business Enterprises (SBE) maximum feasible opportunity to participate in City of Madison contracting. The bidder acknowledges that its bid has been submitted in accordance with the SBE program and is for the public's protection and welfare.

Please refer to the "ADVERTISEMENT FOR BIDS" for the goal for the utilization of SBEs on this project. SBEs may participate as subcontractors, vendors and/or suppliers, which provide a commercially useful function. The dollar value for SBE suppliers or 'materials only' vendors shall be discounted to 60% for purposes of meeting SBE goals.

A bidder which achieves or exceeds the SBE goal will be in compliance with the SBE requirements of this project. In the event that the bidder is unable to achieve the SBE goal, the bidder must demonstrate that a good faith effort to do so was made. Failure to either achieve the goal or demonstrate a good faith effort to do so will be grounds for the bidder being deemed a non-responsible contractor ineligible for award of this contract.

A bidder may count towards its attainment of the SBE goal only those expenditures to SBEs that perform a commercially useful function. For purposes of evaluating a bidder's responsiveness to the attainment of the SBE goal, the contract participation by an SBE is based on the percentage of the total base bid proposed by the Contractor. The total base bid price is inclusive of all addenda.

Work performed by an SBE firm in a particular transaction can be counted toward the goal only if it involves a commercially useful function. That is, in light of industry practices and other relevant considerations, does the SBE firm have a necessary and useful role in the transaction, of a kind for which there is a market outside the context of the SBE Program, or is the firm's role a superfluous step added in an attempt to obtain credit towards goals? If, in the judgment of the Affirmative Action Division, the SBE firm will not perform a commercially useful function in the transaction, no credit towards goals will be awarded.

The question of whether a firm is performing a commercially useful function is completely separate from the question of whether the firm is an eligible SBE. A firm is eligible if it meets the definitional criteria and ownership and control requirements, as set forth in the City of Madison's SBE Program.

If the City of Madison determines that the SBE firm is performing a commercially useful function, then the City of Madison must then decide what that function is. If the commercially useful function is that of an SBE vendor / supplier that regularly transacts business with the respective product, then the City of Madison will count 60% of the value of the product supplied toward SBE goals.

To be counted, the SBE vendor / supplier must be engaged in selling the product in question to the public. This is important in distinguishing an SBE vendor / supplier, which has a regular trade with a variety of customers, from a firm which performs supplier-like functions on an ad hoc basis or for only one or two contractors with whom it has a special relationship.

A supplier of bulk goods may qualify as an eligible SBE vendor / supplier if it either maintains an inventory or owns or operates distribution equipment. With respect to the distribution equipment; e.g., a fleet of trucks, the term "operates" is intended to cover a situation in which the supplier leases the equipment on a regular basis for its entire business. It is not intended to cover a situation in which the firm simply provides drivers for trucks owned or leased by another party; e.g., a prime contractor, or leases such a party's trucks on an ad hoc basis for a specific job.

If the commercially useful function being performed is not that of a qualified SBE vendor / supplier, but rather that of delivery of products, obtaining bonding or insurance, procurement of personnel, acting as a broker or manufacturer's representative in the procurement of supplies, facilities, or materials, etc., only the fees or commissions will apply towards the goal.

For example, a business that simply transfers title of a product from manufacturer to ultimate purchaser; e. g., a sales representative who re-invoices a steel product from the steel company to the Contractor, or a firm that puts a product into a container for delivery would not be considered a qualified SBE vendor / supplier. The Contractor would not receive credit based on a percentage of the cost of the product for working with such firms.

Concerning the use of services that help the Contractor obtain needed supplies, personnel, materials or equipment to perform a contract: only the fee received by the service provider will be counted toward the goal. For example, use of a SBE sales representative or distributor for a steel company, if performing a commercially useful function at all, would entitle the Contractor receiving the steel to count only the fee paid to the representative or distributor toward the goal. This provision would also govern fees for professional and other services obtained expressly and solely to perform work relating to a specific contract.

Concerning transportation or delivery services: if an SBE trucking company picks up a product from a manufacturer or a qualified vendor / supplier and delivers the product to the Contractor, the commercially useful function it is performing is not that of a supplier, but simply that of a transporter of goods. Unless the trucking company is itself the manufacturer or a qualified vendor / supplier in the product, credit cannot be given based on a percentage of the cost of the product. Rather, credit would be allowed for the cost of the transportation service.

The City is aware that the rule's language does not explicitly mention every kind of business that may contribute work on this project. In administering these programs, the City would, on a case-by-case basis, determine the appropriate counting formula to apply in a particular situation.

## **2.2 Contract Compliance**

Questions concerning the SBE Program shall be directed to the Contract Compliance Officer of the City of Madison Department of Civil Rights, Affirmative Action Division, 210 Martin Luther King, Jr. Blvd., Room 523, Madison, WI 53703; telephone (608) 266-4910.



## 2.3 Certification of SBE by City of Madison

The Affirmative Action Division maintains a directory of SBEs which are currently certified as such by the City of Madison. Contact the Contract Compliance Officer as indicated in Section 2.2 to receive a copy of the SBE Directory or you may access the SBE Directory online at [www.cityofmadison.com/dcr/aaTBDir.cfm](http://www.cityofmadison.com/dcr/aaTBDir.cfm).

All contractors, subcontractors, vendors and suppliers seeking SBE status must complete and submit the **Targeted Business Certification Application** to the City of Madison Affirmative Action Division by the time and date established for receipt of bids. A copy of the Targeted Business Certification Application is available by contacting the Contract Compliance Officer at the address and telephone indicated in Section 2.2 or you may access the Targeted Business Certification Application online at [www.cityofmadison.com/dcr/aaTBDir.cfm](http://www.cityofmadison.com/dcr/aaTBDir.cfm). Submittal of the Targeted Business Certification Application by the time specified does not guarantee that the applicant will be certified as a SBE eligible to be utilized towards meeting the SBE goal for this project.

## 2.4 Small Business Enterprise Compliance Report

### 2.4.1 Good Faith Efforts

Bidders shall take all necessary affirmative steps to assure that SBEs are utilized when possible and that the established SBE goal for this project is achieved. A contractor who self performs a portion of the work, and is pre-qualified to perform that category of work, may subcontract that portion of the work, but shall not be required to do so. When a bidder is unable to achieve the established SBE goal, the bidder must demonstrate that a good faith effort to do so was made. Such a good faith effort should include the following:

- 2.4.1.1 Attendance at the pre-bid meeting.
- 2.4.1.2 Using the City of Madison's directory of certified SBEs to identify SBEs from which to solicit bids.
- 2.4.1.3 Assuring that SBEs are solicited whenever they are potential sources.
- 2.4.1.4 Referring prospective SBEs to the City of Madison Affirmative Action Division for certification.
- 2.4.1.5 Dividing total project requirements into smaller tasks and/or quantities, where economically feasible, to permit maximum feasible SBE participation.
- 2.4.1.6 Establishing delivery schedules, where requirements permit, which will encourage participation by SBEs.
- 2.4.1.7 Providing SBEs with specific information regarding the work to be performed.
- 2.4.1.8 Contacting SBEs in advance of the deadline to allow such businesses sufficient time to prepare a bid.
- 2.4.1.9 Utilizing the bid of a qualified and competent SBE when the bid of such a business is deemed reasonable (i.e. 5% above the lowest bidder), although not necessarily low.
- 2.4.1.10 Contacting SBEs which submit a bid, to inquire about the details of the bid and confirm that the scope of the work was interpreted as intended.

### 2.4.2 Reporting SBE Utilization and Good Faith Efforts

The Small Business Enterprise Compliance Report is to be submitted by the bidder with the bid. This report is due by the specified bid closing time and date. Bids submitted without a completed SBE Compliance Report as outlined below

shall be deemed non-responsible and the bidder ineligible for award of this contract.

2.4.2.1 If the Bidder meets or exceeds the goal established for SBE utilization, the Small Business Enterprise Compliance Report shall consist of the following:

2.4.2.1.1 **Cover Page**, Page C-6; and

2.4.2.1.2 **Summary Sheet**, C-7.

2.4.2.2 If the bidder does not meet the goal established for SBE utilization, the Small Business Enterprise Compliance Report shall consist of the following:

2.4.2.2.1 **Cover Page**, Page C-6;

2.4.2.2.2 **Summary Sheet**, C-7; and

2.4.2.2.3 **SBE Contact Report**, C-8 and C-9. (A separate Contact Report must be completed for each applicable SBE which is not utilized.)

## 2.5 Appeal Procedure

A bidder which does not achieve the established goal and is deemed non-responsible for failure to demonstrate a good faith effort to achieve such goal and subsequently denied eligibility for award of contract may, within 72 hours of receiving such notification, appeal that decision to a special appeals committee composed of three (3) members of the Affirmative Action Commission, three (3) members of the Board of Public Works and a seventh member appointed by the Mayor. All appeals must be made in writing to the City Engineer and received within 72 hours of City of Madison's notice. Postmark not applicable.

## 2.6 SBE Requirements After Award of the Contract

The successful bidder shall identify SBE subcontractors, suppliers and vendors on the subcontractor list in accordance with the specifications. The Contractor shall submit a detailed explanation of any variances between the listing of SBE subcontractors, vendors and/or suppliers on the subcontractor list and the Contractor's SBE Compliance Report for SBE participation.

No change in SBE subcontractors, vendors and/or suppliers from those SBEs indicated in the SBE Compliance Report will be allowed without prior approval from the Engineer and the Affirmative Action Division. The contractor shall submit in writing to the City of Madison Affirmative Action Division a request to change any SBE citing specific reasons which necessitate such a change. The Affirmative Action Division will use a general test of reasonableness in approving or rejecting the contractor's request for change. If the request is approved, the Contractor will make every effort to utilize another SBE if available.

The City will monitor the project to ensure that the actual percentage commitment to SBE firms is carried out.

## **2.7 SBE Definition and Eligibility Guidelines**

A Small Business Enterprise is a business concern awarded certification by the City of Madison. For the purposes of this program a Small Business Enterprise is defined as:

- A. An independent business operated under a single management. The business may not be a subsidiary of any other business and the stock or ownership may not be held by any individual or any business operating in the same or a similar field. In determining whether an entity qualifies as a SBE, the City shall consider all factors relevant to being an independent business including, but not limited to, the date the business was established, adequacy of its resources for the work in which it proposes to involve itself, the degree to which financial, equipment leasing and other relationships exist with other ineligible firms in the same or similar lines of work. SBE owner(s) shall enjoy the customary incidents of ownership and shall share in the risks and profits commensurate with their enjoyment interests, as demonstrated by an examination of the substance rather than form or arrangements that may be reflected in its ownership documents.
- B. A business that has averaged no more than \$4.0 million in annual gross receipts over the prior three year period and the principal owner(s) do not have a personal net worth in excess of \$1.32 million.

Firm and/or individuals that submit fraudulent documents/testimony may be barred from doing business with the City and/or forfeit existing contracts.

SBE certification is valid for one (1) year unless revoked.

**HIGHLAND MANOR STORM SHELTER (BUILDING COMPONENT)  
CONTRACT NO. 7343**

**Small Business Enterprise Compliance Report**

**This information may be submitted electronically through  
Bid Express or submitted with bid in sealed envelope.**

**Cover Sheet**

Prime Bidder Information

Company: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone Number: \_\_\_\_\_ Fax Number: \_\_\_\_\_

Contact Person/Title: \_\_\_\_\_

Prime Bidder Certification

I, \_\_\_\_\_, \_\_\_\_\_ of  
Name Title

\_\_\_\_\_ certify that the information  
Company

contained in this SBE Compliance Report is true and correct to the best of my knowledge and belief.

\_\_\_\_\_  
Witness' Signature

\_\_\_\_\_  
Bidder's Signature

\_\_\_\_\_  
Date

**HIGHLAND MANOR STORM SHELTER (BUILDING COMPONENT)  
CONTRACT NO. 7343**

**Small Business Enterprise Compliance Report**

**Summary Sheet**

SBE Subcontractors Who Are NOT Suppliers

| Name(s) of SBEs Utilized                   | Type of Work | % of Total Bid Amount |
|--|--------------|-----------------------|
|  |              | %                     |
|  |              | %                     |
|  |              | %                     |
|  |              | %                     |
|  |              | %                     |
|  |              | %                     |
|  |              | %                     |
|  |              | %                     |
|  |              | %                     |
|  |              | %                     |
|  |              | %                     |
|  |              | %                     |
|  |              | %                     |
|  |              | %                     |
|  |              | %                     |
| <b>Subtotal SBE who are NOT suppliers:</b> |              | _____ %               |

SBE Subcontractors Who Are Suppliers

| Name(s) of SBEs Utilized                             | Type of Work | % of Total Bid Amount                       |
|--|--------------|---|
|  |              | %   |
|  |              | %   |
|  |              | %   |
|  |              | %   |
|  |              | %   |
|  |              | %   |
|  |              | %   |
| <b>Subtotal Contractors who are suppliers:</b>       |              | _____ % x 0.6 = _____ % (discounted to 60%) |
| <b>Total Percentage of SBE Utilization:</b> _____ %. |              |   |

**HIGHLAND MANOR STORM SHELTER (BUILDING COMPONENT)  
CONTRACT NO. 7343**

**Small Business Enterprise Compliance Report**

**SBE Contact Report**

Submit separate copy of this form for each SBE which you are not able to utilize towards meeting the SBE goal for this project. Attach separate sheets if necessary.

SBE Information

Company: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone Number: \_\_\_\_\_

Contact Person/Title: \_\_\_\_\_

1. Outline below all efforts to solicit a bid from the above SBE. Include date, means of contact, who from your company made this contact and the result.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. Describe the information provided to the aforementioned SBE regarding the scope of work for which he/she was to provide a bid.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Is this the same scope of work on which the subcontractor you intend to utilize based his/her bid?

☐ Yes    ☐ No

3. Did this SBE submit a bid?    ☐ Yes    ☐ No

4. Is the General Contractor pre-qualified to self-perform this category of work?

☐ Yes    ☐ No

5. If you responded "Yes" to Question 3, please check the items below which apply and provide the requested detail. If you responded "No" to Question 3, please skip ahead to item 6 below.

☐ The SBE listed above is unavailable for work on this project for the following reasons. Provide specific detail for this conclusion.

---

---

☐ The SBE listed above is unqualified for work on this project. Provide specific details for this conclusion.

---

---

☐ The SBE listed above provided a price that was unreasonable (i.e. more than 5% above the lowest bidder). Provide specific detail for this conclusion including the SBE's price and the price of the subcontractor you intend to utilize.

---

---

☐ A contract with the SBE listed above may constitute a breach of the bidder's collective bargaining agreements. Provide specific detail for this conclusion including, but not limited to, correspondence from the SBE indicating it will not sign a project labor agreement and/or correspondence from the applicable trade union indicating a project labor agreement will not be allowed at the time of project bidding.

---

---

☐ Other; please specify reason(s) other than listed above which made it impossible for you to utilize this SBE on this project.

---

---

6. Describe any other good faith efforts:

---

---

## **SECTION D: SPECIAL PROVISIONS**

### **HIGHLAND MANOR STORM SHELTER (BUILDING COMPONENT) CONTRACT NO. 7343**

It is the intent of these Special Provisions to set forth the final contractual intent as to the matter involved and shall prevail over the Standard Specifications and plans whenever in conflict therewith. In order that comparisons between the Special Provisions can be readily made, the numbering system for the Special Provisions is equivalent to that of the Specifications.

Whenever in these Specifications the term "Standard Specifications" appears, it shall be taken to refer to the City of Madison Standard Specifications for Public Works Construction and Supplements thereto.

#### **SECTION 102.10: PREVAILING WAGE**

The wages and benefits paid on this contract shall be in accordance with both of the following minimum wage rates contained in Section J.

- 1) U.S. Department of Labor Davis-Bacon Act Minimum Wage Rates
- 2) Prevailing Wage Rate Determination issued by the State of Wisconsin Department of Workforce Development (Building or Heavy Construction)

The wages and benefits paid on the contract shall not be less than those specified in Section J

For those projects subject to the requirements of the Davis-Bacon Act, the Secretary of Labor will also have determined "Minimum Wage Rates" for work to be performed under the contract. These rates are, for all or most of the labor, worker, mechanic or truck driver classifications, identical to those established under Section 103.50 of the Wisconsin Statutes. In the event the rates are not identical, the higher of the two rates will govern.

#### **SECTION 102.12: BEST VALUE CONTRACTING**

This Contract shall be considered a Best Value Contract if the Contractor's bid is equal to or greater than \$54,000 for a single trade contract; or equal to or greater than \$264,500 for a multi-trade contract pursuant to MGO 33.07(7).

#### **SECTION 104: SCOPE OF WORK**

The project is for the construction of a new 1-story building, including site development work, for Highland Manor Community Safe Room located within vacant City of Madison Park Lands, surrounded by the existing Highland Manor Mobile Home Park in Madison, Wisconsin. The new community safe room will provide emergency shelter for approximately 806 occupants. It will provide near-absolute protection from extreme wind events and must be constructed in accordance with FEMA 361. The gross area of the new building will be approximately 6400 square feet with the net area of the Safe Room at approximately 4,170 square feet.

The intent of the plans and specifications is to provide for the construction, execution and completion of a complete work of improvements, which the contractor undertakes to do in full compliance with the plans, specifications, and contract. The Contractor shall not scale drawings for exact dimensions. Bidders are encouraged to visit the site prior to bidding, to become familiar with and verify existing job conditions. Work shall comply with all applicable codes and regulations. The work: shall be performed by tradesmen skilled in the area of work included in this contract; shall be of professional quality; and shall be completed according to the best practice of the trade. Workers shall be knowledgeable with regard to products used and shall take appropriate precautions required to safeguard health and safety.



General Considerations:

The Contractor shall supply portable toilet facilities for the construction workers as needed. The Contractor shall supply temporary potable water for construction and other purposes until the permanent water supply system is accepted and in operation. The Contractor shall provide temporary power to the new construction area. Portable generators shall be located to minimize impacts to adjacent neighbors, must comply with noise Ordinance requirements, and cannot be running prior to 7:00 am or after 7:00 pm. Permanent electrical distribution system, wiring, fixtures, and outlets shall not be used for temporary light and power without the approval of the Architect. The Contractor shall furnish lamps and extension cords as required for their work.

The Contractor shall provide and maintain temporary floor and equipment supports, ramps, bridges, etc., as required to permit full and safe use of building during construction and remove such temporary work as soon as possible. All fabric or plastic films used for temporary enclosures shall be certified as conforming to the requirements of Test Method #2 contained in NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

For Bidding Purposes, questions pertaining to this project shall be directed to:

Hamid Noughani, A.I.A.  
Assemblage Architects  
7427 Elmwood Ave.  
Middleton, Wisconsin 53562  
Phone: (608) 827-5047  
[noughani@assemblagearchitects.com](mailto:noughani@assemblagearchitects.com)

**OR**

James Whitney, A.I.A.  
City of Madison  
Dept. of Public Works, Engineering Division  
City-County Building, Room 115  
210 Martin Luther King Jr. Blvd.  
Madison, WI 53703  
(608) 266-4563  
[jwhitney@cityofmadison.com](mailto:jwhitney@cityofmadison.com)

The Bid Proposal is set up such that the building is bid lump sum as a complete unit including closely related items on the exterior perimeter of the building or attached to the building. The site plan work is broken down into individual bid items to better accommodate some of the unknowns or quantity fluctuations.

**105.12 COOPERATION BY CONTRACTOR**

The City of Madison Engineering Operations will be responsible for installation of the sanitary sewer external to the building perimeter. The Contractor shall coordinate all work performed by the City of Madison by giving a minimum of 5 working days notice of when this work may be performed. The contact for the City of Madison Engineering Operations is Jim Martinson (608-267-1973). The Contractor shall allow up to 3 working days in his / her schedule for this installation. During this time, the Contractor may perform other work provided it does not interfere with the City Engineering work.

The Contractor shall also coordinate their work to allow access to other utility companies to install new facilities to serve the building and resolve any conflicts that may arise.

### **105.13 ORDER OF COMPLETION**

The Contractor shall schedule a Preconstruction meeting with City staff at least 7 calendar days before starting construction. The Contractor shall provide a schedule for work with a detail of the order of completion.

### **SECTION 106.1: SOURCE OF SUPPLY AND QUALITY**

Submit shop drawings and product data, drawings, manufacturer specifications, installation instructions, maintenance instructions and general recommendations to the Architect for review. Include data substantiating that materials comply with the specifications.

Submit additional information which may be required under separate sections of these specifications.

The Contractor shall review all submittals and shop drawings for conformity with the contract documents and shall stamp and note their review and approval by initialing document prior to submitting.

Materials and equipment for this project shall be from items specified or items approved as equal, in writing, by the Architect at least five (5) calendar days prior to bid receipt date.

Request for approval of materials or items of equipment as equal to that specified shall be submitted in writing from the Contractor accompanied by data adequate to establish such equality and by citation of at least two (2) situations where such materials and/or items of equipment have been successfully used including references. The Architect's decision as to quality or relative merit of item or substitution shall be final.

Deliver materials to job site and store in a safe area, out of the way of traffic and stored up off ground surface. Protect materials before, during and after delivery to job site. The contractor shall be responsible for damage to construction materials prior to final acceptance of completed contract.

### **107.1 PUBLIC CONVENIENCE AND SAFETY**

Incidental to the Construction, the Contractor shall provide signage along Manor Drive in both directions, warning of the construction area and construction traffic that may be turning onto and off of Manor Drive from the work site. The Contractor shall install safety fence (pay item) as shown on the plans or as directed in the field by the Engineer or Architect.

### **108.2 PERMITS and LICENSING**

The Contractor shall obtain and pay for permits and private utility installation fees for this project unless otherwise provided. Few, if any are anticipated. An allowance of \$1,000 is provided for these costs (see bid item #90010). The Contractor shall provide evidence of payment for reimbursement under the allowance. Reimbursement shall be limited to only the actual cost paid by the Contractor, with the allowance amount paid increasing or decreasing based on final costs of permits and / or installation fees. It is assumed these costs will include but may not be limited to: electric; telephone; and gas and water service / meter set.

The Contractor shall be responsible for compliance with all permits including the City of Madison Erosion Control permit and the Wisconsin Department of Natural Resources WRAPP Storm Water NOI permit, all of which have already been obtained by the City and are included in these Special Provisions as a reference.

The Contractor shall be responsible for any fines issued due to non-compliance with the project permits.

## **SECTION 109.2: PROSECUTION OF THE WORK**

Construction work must begin on or before **September 2, 2014** or within seven (7) calendar days after the date appearing on the mailed notice to do so and shall be carried on at a rate so as to secure full completion on or before **June 1, 2015**, the rate of progress and the time of completion being essential conditions of the Agreement. The fixed, agreed upon, liquidated damages for failure to complete all work within the Contract Time, shall be calculated in accordance with ARTICLE 109 of the Standard Specifications. Failure to complete the exterior items by the interim completion date shall also be subject to liquidated damages.

The building concrete foundation work shall be completed on or before November 26, 2014.

The parking lot asphalt work and the site concrete work shall be installed in April/May 2015.

Site work shall begin on or after September 15, 2014.

Under a separate contract No. 7319 a grading contractor will be working on the building site until the building pad settlement (surcharge) is complete. The building contractor shall not have access or use of the site until the building pad settlement work is complete and the grading contractor's work is complete. The building pad settlement work is scheduled for completion on or before September 15, 2014.

The building pad settlement work in contract No. 7319 is not in contract and is described below for reference purposes only:

In accordance with the Site Preparation Recommendations in CGC's September 3, 2013 Geotechnical Report; after subgrade preparation, fill is to be placed within and 10 ft. beyond the building limits proposed building pad, 4 to 6 weeks prior to beginning foundation excavation. This is being done to allow most of the settlement due to the weight of the new fill to occur prior to beginning foundation construction. Three to five settlement platforms (see Appendix E of the Geotechnical Report for detail) should be installed within the building footprint to document that settlement has ceased prior to beginning foundation excavation. The settlement platforms should be surveyed immediately after grading and fill placement to the floor slab subgrade elevation occurs, and on a weekly basis until three consecutive readings at each settlement platform show that settlement has ceased. Cut and fill grading and placement of fill material to the floor slab subgrade elevation should occur first, followed by a 4 to 6 week period where the underlying soils can consolidate prior to the footings being excavated through the new fill.

### **BID ITEM 20221 – 4" TOPSOIL**

This item is for imported topsoil for all areas to be seeded around the building and parking lot and Southwest of Manor Drive. This includes providing and placing a 4" thick, layer of topsoil imported by the Contractor, and preparing the area for seeding.

### **BID ITEM 20701 – TERRACE SEEDING (INCLUDING MULCH)**

Terrace Seeding (Including Mulch) shall be used on all areas to be seeded and mulched. The seed mix and method of measurement shall be in accordance with the Standard Specifications.

### **BID ITEM 30301 – 5 INCH CONCRETE SIDEWALK**

All 5 inch concrete sidewalks shall be installed in accordance with design location, dimensions, and details shown in the plan and site details. Refer to the Standard Spec – Part 3 for construction methods and material specifications.

### **BID ITEM 90000 – CONSTRUCTION OF COMMUNITY SAFE ROOM BUILDING - COMPLETE**

This bid item shall include the complete construction of the one story structure, including some incidental site development work as defined by plans and these special provisions. Most of the related site work will have separate bid items. Any work within 20 feet of the building that does not have a specific bid item,

shall be considered incidental to the building and this bid item. The gross area of the new building shall be approximately 6400 square feet and the net safe room area approximately 4,170 square feet. The building must be constructed in accordance with FEMA 361. For purposes of bidding, the emergency generator and the outdoor mechanical area where it is housed, including the concrete screening wall and concrete pad, are all considered part of this bid item. Also included are all roof or wall penetrations, conduits or sleeves required for future antenna or signal wiring.

#### **BID ITEM 90001 - UNDERCUT**

Additional, unforeseen excavation, including undercutting of poor soil discovered during construction shall be measured in the field by volume in cubic yards. Undercut shall also include placement and compaction of select backfill (crushed aggregate base course) into the excavated area. Undercut areas and depths shall be determined in the field at the time of proof rolling, by the Engineer or the Engineer's representative.

#### **BID ITEM 90002 / BID ITEM 90003 – MOUNTABLE CONCRETE CURB AND GUTTER**

Mountable Concrete Curb and Gutter shall be installed in accordance to design location, dimensions and details of contract plan set.

Measurement of payment and basis of payment shall be by linear foot in accordance of section 302.3 of the Standard Spec.

#### **BID ITEM 90004 – ACCESSIBLE SIGN**

Accessible Sign shall be installed at the locations shown on the plan set and in accordance to dimensions and details shown in the site details.

Accessible Sign shall be measured by units of each and shall include all materials and labor necessary to perform work and all other work incidental to the installation of accessible sign.

#### **BID ITEM 90005 – CONCRETE WHEEL STOP**

Concrete wheel stop shall be installed at the locations shown on the plan set and in accordance to dimensions and details shown in the site details.

Concrete wheel stop shall be measured by units of each and shall include all materials and labor necessary to perform work and all other work incidental to the installation of a concrete wheel stop.

#### **BID ITEM 90006 – CONSTRUCTION FENCE**

Construction Fence shall be installed at the locations shown on the plan set and in accordance to dimensions and details shown in the site details.

Construction Fence shall be measured by units of linear feet and shall include all materials and labor necessary to perform work and all other work incidental to the installation of construction fence.

#### **BID ITEM 90007 – BIKE RACK**

Bike Rack shall be installed at the location specified and shown on the plan set and in accordance with the detail in these special provisions.

Bike Rack shall be measured by units of each and shall include all materials and labor necessary to perform work and all other work incidental to the installation of the bike rack.

#### **BID ITEM 90008 – PAVEMENT MARKINGS**

This bid item shall be for all pavement markings as shown on the plans, completed as described in these special provisions (Section 32 17 23). Payment shall be on a Lump Sum basis for all lines, symbols, and cross hatching required.

#### **BID ITEM 90009 – VERTICAL CURB**

Vertical Curb shall be installed in accordance with the locations, dimensions and details as shown on the plan set.

Measurement for payment and basis of payment for Vertical Curb shall be by the linear foot and in accordance with Section 302.3 of the Standard Specifications. Payment by the linear foot shall include all materials and labor necessary to perform the work and all other work incidental to the installation of the Vertical Curb.

#### **BID ITEM 90010 – UTILITY & PERMIT ALLOWANCE**

Utility & Permit Allowance shall be used to cover charges the Contractor may incur to obtain permits or connections from a Utility Company which are necessary for the completion of the project. This only reimburses out of pocket payments the Contractor has made for said expenses and shall not cover any costs for Contractor coordination or work the Contractor is otherwise obligated to perform to facilitate these connections.

Payment for Utility & Permit Allowance shall be the actual amount of expense incurred by the Contractor based upon paid receipts. The final payment amount may be more or less than the amount estimated for allowance in the contract, and shall be adjusted based upon the final actual amount of these expenses incurred by the Contractor to Utilities or the permitting authority.

#### **BID ITEM 90011 – VERTICAL PIPE INLET**

Vertical Pipe Inlet shall be constructed as shown in site utility details. Final grade for the vertical pipe inlet shall be set to final grade.

Vertical Pipe Inlet shall be measure as a unit of each and shall include furnishing all materials necessary to perform the work, including the castings; excavation; disposal of surplus material from excavation; backfilling the excavation and compaction of the backfill material; preparation of the foundation; construction of the structure; connection of new pipes; cleaning out the structure; restoring the site; and all other work incidental to the installation of vertical pipe inlet.

#### **BID ITEM 90012 – DOWNSPOUT TERMINATION**

Downspout Termination shall be installed at the locations shown on the plan set and in accordance to dimensions and details shown in the site details.

Downspout Termination shall be measured by units of each and shall include all materials and labor necessary to perform work and all other work incidental to the installation of a downspout termination.

#### **BID ITEM 90013 – STORM PVC PIPE FITTINGS**

Storm PVC Fittings shall be installed at the sizes, types, and locations specified and shown on the plan set and in accordance with the Standard Specifications for the installation of PVC pipe and fittings.

Storm PVC Fittings shall be measured by units of each, regardless of size and type of fitting and shall include all materials and labor necessary to perform the work and all other work incidental to the installation of the fittings.

#### **BID ITEM 90014 – TRENCH BACKFILL FOR WATERMAIN**

Work under this item shall include placement and compaction of select fill bedding material beneath, around and 12 inches over the water main in accordance with the Standard Specifications. Fill for the remainder of the trench shall be with the native material excavated from the trench for installation, re-compacted to 90% density. Where the watermain crosses Manor Drive, the contractor shall place and compact select fill the entire trench depth in accordance with the Standard Specifications and incidental to this item.

Measurement and Payment for Trench Backfill for Watermain shall be by the trench foot for all placement and compaction of the trench backfill in accordance with this provision and the Standard Specifications.

# Highland Manor Community Safe Room

## City of Madison

Contract No. 7343

Technical Specifications

**Bid Documents**

**May 30, 2014**

Prepared by

Assemblage Architects  
7427 Elmwood Avenue  
Middleton, WI 53562  
608-827-5047

Arnold and O'Sheridan  
726 Heartland Trail, Suite 280  
Madison, WI 53717  
608.821.8407

Oneida Total Integrated Enterprises (OTIE)  
5100 Eastpark Blvd, suite 200  
Madison, WI 53718  
608.241.6715 office

This Page Intentionally Left Blank



## TABLE OF CONTENTS

### DIVISION 01 - GENERAL REQUIREMENTS

|          |                                     |
|----------|-------------------------------------|
| 01 10 00 | SUMMARY                             |
| 01 31 00 | PROJECT MANAGEMENT AND COORDINATION |
| 01 33 00 | SUBMITTAL PROCEDURES                |
| 01 40 00 | QUALITY REQUIREMENTS                |
| 01 42 00 | REFERENCES                          |
| 01 77 00 | CLOSEOUT PROCEDURES                 |
| 01 78 39 | PROJECT RECORD DOCUMENTS            |

### DIVISION 02 - EXISTING CONDITIONS

NOT APPLICABLE

### DIVISION 03 - CONCRETE

|          |                                     |
|----------|-------------------------------------|
| 03 12 00 | CONCRETE FORMWORK                   |
| 03 21 13 | REINFORCING STEEL                   |
| 03 30 00 | CAST-IN-PLACE CONCRETE              |
| 03 41 00 | PRECAST STRUCTURAL CONCRETE         |
| 03 41 13 | PRECAST CONCRETE HOLLOW CORE PLANKS |
| 03 41 50 | PRECAST CONCRETE PANELS             |

### DIVISION 04 - MASONRY

|          |              |
|----------|--------------|
| 04 20 00 | UNIT MASONRY |
|----------|--------------|

### DIVISION 05 - METALS

|          |                          |
|----------|--------------------------|
| 05 12 00 | STRUCTURAL STEEL FRAMING |
|----------|--------------------------|

### DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

NOT APPLICABLE

### DIVISION 07 - THERMAL AND MOISTURE PROTECTION

|          |   |
|----------|---|
| 07 13 26 | SELF-ADHERING SHEET WATERPROOFING               |
| 07 53 23 | ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING |
| 07 71 00 | ROOF SPECIALTIES                                |
| 07 92 00 | JOINT SEALANTS                                  |

## DIVISION 08 - OPENINGS

|          |   |
|----------|---|
| 08 11 00 | STEEL DOORS AND FRAMES                    |
| 08 41 13 | ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS |
| 08 80 00 | GLAZING                                   |
| 08 71 00 | DOOR HARDWARE                             |

## DIVISION 09 - FINISHES

|          |                           |
|----------|---------------------------|
| 09 30 00 | TILING                    |
| 09 51 13 | ACOUSTICAL PANEL CEILINGS |
| 09 91 13 | EXTERIOR PAINTING         |
| 09 91 23 | INTERIOR PAINTING         |

## DIVISION 10 - SPECIALTIES

|          |                                       |
|----------|---------------------------------------|
| 10 21 13 | TOILET COMPARTMENTS                   |
| 10 28 00 | TOILET, BATH, AND LAUNDRY ACCESSORIES |
| 10 44 13 | FIRE EXTINGUISHER CABINETS            |

## DIVISION 11 - EQUIPMENT

NOT APPLICABLE

## DIVISION 12 - FURNISHINGS

NOT APPLICABLE

## DIVISION 13 - SPECIAL CONSTRUCTION

NOT APPLICABLE

## DIVISION 14 - CONVEYING EQUIPMENT

NOT APPLICABLE

## DIVISION 21 - FIRE SUPPRESSION

|          |                                      |
|----------|--------------------------------------|
| 21 00 00 | FIRE PROTECTION SYSTEM SPECIFICATION |
|----------|--------------------------------------|

## DIVISION 22 - PLUMBING

|          |                                       |
|----------|---------------------------------------|
| 22 01 00 | OPERATION AND MAINTENANCE OF PLUMBING |
| 22 05 00 | COMMON WORK RESULTS FOR PLUMBING      |
| 22 05 25 | PLUMBING SPECIALTIES                  |
| 22 07 00 | PLUMBING INSULATION                   |
| 22 11 00 | FACILITY WATER DISTRIBUTION           |
| 22 13 00 | DRAIN AND VENT                        |
| 22 30 00 | PLUMBING EQUIPMENT                    |

## DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

|          |   |
|----------|---|
| 23 05 00 | COMMON WORK RESULTS FOR HVAC                      |
| 23 05 13 | COMMON WORK RESULTS FOR HVAC EQUIPMENT            |
| 23 05 29 | HANGERS AND SUPPORT FOR HVAC PIPING AND EQUIPMENT |
| 23 05 93 | TESTING, ADJUSTING AND BALANCING                  |
| 23 07 00 | HVAC INSULATION                                   |
| 23 09 23 | DIRECT DIGITAL CONTROL SYSTEM FOR HVAC            |
| 23 09 93 | SEQUENCING OF OPERATION FOR HVAC CONTROLS         |
| 23 11 00 | NATURAL GAS FUEL SYSTEMS                          |
| 23 23 00 | REFRIGERANT PIPING                                |
| 23 31 00 | HVAC DUCTS AND CASING                             |
| 23 33 00 | AIR DUCT ACCESSORIES                              |
| 23 37 13 | DIFFUSERS, REGISTERS AND GRILLES                  |
| 23 41 00 | PARTICULATE AIR FILTRATION                        |
| 23 51 00 | BREECHING, CHIMNEY AND STACKS                     |
| 23 54 00 | FURNACES  |
| 23 63 13 | AIR COOLED CONDENSING UNITS                       |
| 23 72 23 | FIXED PLATE AIR-TO-AIR ENERGY RECOVERY EQUIPMENT  |
| 23 82 13 | TERMINAL HEATING UNITS (ELECTRICAL)               |

## DIVISION 25 - INTEGRATED AUTOMATION

NOT APPLICABLE

## DIVISION 26 - ELECTRICAL

|            |   |
|------------|---|
| 26 05 00   | COMMON WORK RESULTS FOR ELECTRICAL              |
| 26 05 04   | INSPECTION AND TESTING FOR ELECTRICAL EQUIPMENT |
| 26 05 19   | LOW VOLTAGE WIRES, CABLES AND CONNECTORS        |
| 26 05 19.4 | MOTOR WIRING                                    |
| 26 05 26   | GROUNDING                                       |
| 26 05 29   | SUPPORTING DEVICES                              |
| 26 05 33   | CONDUITS  |
| 26 05 33.1 | ELECTRICAL BOXES                                |
| 26 24 16   | ELECTRICAL PANELBOARDS                          |
| 26 27 26   | WIRING DEVICES                                  |
| 26 27 27   | OCCUPANCY SENSORS                               |
| 26 27 28   | MOTOR AND CIRCUIT DISCONNECTS                   |
| 26 28 00   | LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES      |
| 26 29 00   | MOTOR STARTERS                                  |
| 26 31 11   | DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM          |
| 26 32 00   | STANDBY POWER GENERATOR                         |
| 26 36 23   | AUTOMATIC TRANSFER EQUIPMENT                    |

DIVISION 27 - COMMUNICATIONS

NOT APPLICABLE

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

NOT APPLICABLE

DIVISION 31 - EARTHWORK

31 20 00      EARTH MOVING

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 17 23      PAVMENT MARKINGS

## SECTION 01 10 00 - SUMMARY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Project information.
  - 2. Work covered by Contract Documents.
  - 3. Work by Owner.
  - 4. Owner-furnished products.
  - 5. Access to site.

#### 1.3 PROJECT INFORMATION

- A. Project Identification: Highland Manor Community Saferoom.
  - 1. Project Location: 10 Manor Drive, Madison, WI.
- B. Owner: City of Madison
  - 1. Owner's Representative: Mike Dailey, PE
- C. Architect: Assemblage Architects, 7427 Elmwood Ave, Middleton, WI 53562. 608-827-5047
- D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
  - 1. Structural, Mechanical, Electrical, Plumbing, Fire Protection, Data Telcomm: Arnold and O'Sheridan Engineers
  - 2. Civil: Oneida Total Integrated Enterprises (OTIE)
- E. Other Owner Consultants: The Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:
  - 1. Site utilities: City of Madison Engineering Department.

#### 1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
  - 1. The building is approximately 7000 SF with precast and masonry components. It is an assembly occupancy.
- B. Type of Contract:
  - 1. Project will be constructed under a single prime contract.

#### 1.5 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
  - 1. Security system and associated door contacts, communication lines, and communication panel.
  - 2. Data system including cabling, termination devices, and associated panels to the extent required by the contract documents.
  - 3. Communication booster equipment system.
  - 4. Sanitary utility to 5' outside building, contractor to install final connection.
- B. Preceding Work: Owner will perform the following construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.
  - 1. Work performed under separate contract for rough site grading, pad settlement, and water main installation.
- C. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
  - 1. Sanitary utility
- D. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract.
  - 1. Planting prep and materials

## 1.6 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.
- B. Owner-Furnished Products:
  - 1. Baby Changing stations.

## 1.7 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

This Page Intentionally Left Blank



## SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Coordination drawings.
  - 3. Requests for Information (RFIs).
  - 4. Project meetings.

#### 1.3 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

#### 1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

- C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

## 1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
  - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
  - 1. Fire-Protection System: Show the following:
    - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
  - 2. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
  - 3. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

## 1.6 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
  - 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
  - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
  2. Project number.
  3. Date.
  4. Name of Contractor.
  5. Name of Architect.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number including RFIs that were returned without action or withdrawn.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

## 1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Conduct the conference to review responsibilities and personnel assignments.
  2. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Critical work sequencing and long-lead items.
  4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

This Page Intentionally Left Blank

## SECTION 01 33 00 - SUBMITTAL PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

#### 1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

#### 1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
  - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
  - a. Scheduled date for first submittal.
  - b. Specification Section number and title.
  - c. Submittal category: Action; informational.
  - d. Name of subcontractor.
  - e. Description of the Work covered.
  - f. Scheduled date for Architect's final release or approval.

#### 1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
  1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
    - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
    - b. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
    - c. .
    - d. The following digital data files will be furnished for each appropriate discipline:
      - 1) Floor plans.
      - 2) Reflected ceiling plans.
      - 3) .
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.



4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
  - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 days for review of each resubmittal.
  4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- D. Options: Identify options requiring selection by Architect.
- E. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- F. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- G. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- H. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

## PART 2 - PRODUCTS

### 2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Submit electronic submittals via email as PDF electronic files.
    - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
  - 2. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return Insert number copies.
  - 3. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
  - 4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    - a. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
  - 3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  - 4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams showing factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.

- d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- 5. Submit Product Data before or concurrent with Samples.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
  - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  - 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least **8-1/2 by 11 inches**, but no larger than **30 by 42 inches**.
  - 3. BIM File Incorporation: Shop Drawing files into Building Information Model established for Project.
    - a. Prepare Shop Drawings in the following format: Same digital data software program, version, and operating system as the original Drawings.
    - b. Refer to Section 013100 "Project Management and Coordination" for requirements for coordination drawings.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
  - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  - 2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
    - e. Specification paragraph number and generic name of each item.
  - 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
  - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
  - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
  1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.
- F. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."
- G. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."
- J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- K. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."
- L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure

Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

- N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - 1. Name of evaluation organization.
  - 2. Date of evaluation.
  - 3. Time period when report is in effect.
  - 4. Product and manufacturers' names.
  - 5. Description of product.
  - 6. Test procedures and results.
  - 7. Limitations of use.
- U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

- W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

## 2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit **digitally signed PDF electronic file and three** paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM File Incorporation: delegated-design drawing and data files into Building Information Model established for Project.
  - 1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as the original Drawings.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

### 3.2 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 01 33 00

This Page Intentionally Left Blank



## SECTION 01 40 00 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
  - 4. Specific test and inspection requirements are not specified in this Section.

#### 1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

- D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of **five** previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

#### 1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

#### 1.5 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
  - 1. Indicate manufacturer and model number of individual components.
  - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Contractor's quality-control personnel.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

## 1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
  - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
  - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
  - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

## 1.8 REPORTS AND DOCUMENTS

- A. **Manufacturer's Technical Representative's Field Reports:** Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- B. **Factory-Authorized Service Representative's Reports:** Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
  2. Statement that equipment complies with requirements.
  3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  4. Statement whether conditions, products, and installation will affect warranty.
  5. Other required items indicated in individual Specification Sections.
- C. **Permits, Licenses, and Certificates:** For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

## 1.9 QUALITY ASSURANCE

- A. **General:** Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. **Manufacturer Qualifications:** A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. **Fabricator Qualifications:** A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- D. **Installer Qualifications:** A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. **Specialists:** Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. **Testing Agency Qualifications:** An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
  - 1. **NVLAP:** A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. **Manufacturer's Technical Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. **Preconstruction Testing:** Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
  - 1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

#### 1.10 QUALITY CONTROL

- A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
  1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- C. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

#### 1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
  2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
  4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.

5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
  1. Date test or inspection was conducted.
  2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Architect.
  4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00



## SECTION 01 42 00 - REFERENCES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- D. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- E. "Provide": Furnish and install, complete and ready for the intended use.
- F. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

#### 1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

#### 1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

|        |  |
|--------|--|
| AABC   | Associated Air Balance Council<br><a href="http://www.aabc.com">www.aabc.com</a>   |
| AAMA   | American Architectural Manufacturers Association<br><a href="http://www.aamanet.org">www.aamanet.org</a>                                 |
| AASHTO | American Association of State Highway and Transportation Officials<br><a href="http://www.transportation.org">www.transportation.org</a> |
| AATCC  | American Association of Textile Chemists and Colorists<br><a href="http://www.aatcc.org">www.aatcc.org</a>                               |
| ABMA   | American Bearing Manufacturers Association<br><a href="http://www.americanbearings.org">www.americanbearings.org</a>                     |
| ACI    | American Concrete Institute (Formerly: ACI International)<br><a href="http://www.concrete.org">www.concrete.org</a>                      |
| ACPA   | American Concrete Pipe Association<br><a href="http://www.concrete-pipe.org">www.concrete-pipe.org</a>                                   |
| AEIC   | Association of Edison Illuminating Companies, Inc. (The)<br><a href="http://www.aeic.org">www.aeic.org</a>                               |
| AF&PA  | American Forest & Paper Association<br><a href="http://www.afandpa.org">www.afandpa.org</a>  |
| AGA    | American Gas Association<br><a href="http://www.aga.org">www.aga.org</a>   |
| AHAM   | Association of Home Appliance Manufacturers<br><a href="http://www.aham.org">www.aham.org</a>  |
| AHRI   | Air-Conditioning, Heating, and Refrigeration Institute (The)<br><a href="http://www.ahrinet.org">www.ahrinet.org</a>                     |
| AI     | Asphalt Institute<br><a href="http://www.asphaltinstitute.org">www.asphaltinstitute.org</a>  |

|          |  |
|----------|--|
| AIA      | American Institute of Architects (The)<br><a href="http://www.aia.org">www.aia.org</a>   |
| AISC     | American Institute of Steel Construction<br><a href="http://www.aisc.org">www.aisc.org</a>   |
| AISI     | American Iron and Steel Institute<br><a href="http://www.steel.org">www.steel.org</a>  |
| AITC     | American Institute of Timber Construction<br><a href="http://www.aitc-glulam.org">www.aitc-glulam.org</a>                          |
| AMCA     | Air Movement and Control Association International, Inc.<br><a href="http://www.amca.org">www.amca.org</a>                         |
| ANSI     | American National Standards Institute<br><a href="http://www.ansi.org">www.ansi.org</a>  |
| AOSA     | Association of Official Seed Analysts, Inc.<br><a href="http://www.aosaseed.com">www.aosaseed.com</a>                              |
| APA      | APA - The Engineered Wood Association<br><a href="http://www.apawood.org">www.apawood.org</a>                                      |
| APA      | Architectural Precast Association<br><a href="http://www.archprecast.org">www.archprecast.org</a>                                  |
| API      | American Petroleum Institute<br><a href="http://www.api.org">www.api.org</a>   |
| ARI      | Air-Conditioning & Refrigeration Institute<br>(See AHRI)   |
| ARI      | American Refrigeration Institute<br>(See AHRI)   |
| ARMA     | Asphalt Roofing Manufacturers Association<br><a href="http://www.asphaltroofing.org">www.asphaltroofing.org</a>                    |
| ASCE     | American Society of Civil Engineers<br><a href="http://www.asce.org">www.asce.org</a>  |
| ASCE/SEI | American Society of Civil Engineers/Structural Engineering Institute<br>(See ASCE)   |
| ASHRAE   | American Society of Heating, Refrigerating and Air-Conditioning<br>Engineers<br><a href="http://www.ashrae.org">www.ashrae.org</a> |

|       |  |
|-------|--|
| ASME  | ASME International<br>(American Society of Mechanical Engineers)<br><a href="http://www.asme.org">www.asme.org</a>                           |
| ASSE  | American Society of Safety Engineers (The)<br><a href="http://www.asse.org">www.asse.org</a>   |
| ASSE  | American Society of Sanitary Engineering<br><a href="http://www.asse-plumbing.org">www.asse-plumbing.org</a>                                 |
| ASTM  | ASTM International<br>(American Society for Testing and Materials International)<br><a href="http://www.astm.org">www.astm.org</a>           |
| ATIS  | Alliance for Telecommunications Industry Solutions<br><a href="http://www.atis.org">www.atis.org</a>   |
| AWEA  | American Wind Energy Association<br><a href="http://www.awea.org">www.awea.org</a>   |
| AWI   | Architectural Woodwork Institute<br><a href="http://www.awinet.org">www.awinet.org</a>   |
| AWMAC | Architectural Woodwork Manufacturers Association of Canada<br><a href="http://www.awmac.com">www.awmac.com</a>                               |
| AWPA  | American Wood Protection Association<br>(Formerly: American Wood-Preservers' Association)<br><a href="http://www.awpa.com">www.awpa.com</a>  |
| AWS   | American Welding Society<br><a href="http://www.aws.org">www.aws.org</a>   |
| AWWA  | American Water Works Association<br><a href="http://www.awwa.org">www.awwa.org</a>   |
| BHMA  | Builders Hardware Manufacturers Association<br><a href="http://www.buildershardware.com">www.buildershardware.com</a>                        |
| BIA   | Brick Industry Association (The)<br><a href="http://www.gobrick.com">www.gobrick.com</a>   |
| BICSI | BICSI, Inc.<br><a href="http://www.bicsi.org">www.bicsi.org</a>  |
| BIFMA | BIFMA International<br>(Business and Institutional Furniture Manufacturer's Association)<br><a href="http://www.bifma.com">www.bifma.com</a> |

|       |  |
|-------|--|
| BISSC | Baking Industry Sanitation Standards Committee<br><a href="http://www.bissc.org">www.bissc.org</a>   |
| BOCA  | BOCA<br>(Building Officials and Code Administrators International Inc.)<br>(See ICC)   |
| BWF   | Badminton World Federation<br>(Formerly: International Badminton Federation)<br><a href="http://www.bwfbadminton.org">www.bwfbadminton.org</a> |
| CDA   | Copper Development Association<br><a href="http://www.copper.org">www.copper.org</a>   |
| CEA   | Canadian Electricity Association<br><a href="http://www.electricity.ca">www.electricity.ca</a>   |
| CEA   | Consumer Electronics Association<br><a href="http://www.ce.org">www.ce.org</a>   |
| CFFA  | Chemical Fabrics & Film Association, Inc.<br><a href="http://www.chemicalfabricsandfilm.com">www.chemicalfabricsandfilm.com</a>                |
| CFSEI | Cold-Formed Steel Engineers Institute<br><a href="http://www.cfsei.org">www.cfsei.org</a>  |
| CGA   | Compressed Gas Association<br><a href="http://www.cganet.com">www.cganet.com</a>   |
| CIMA  | Cellulose Insulation Manufacturers Association<br><a href="http://www.cellulose.org">www.cellulose.org</a>                                     |
| CISCA | Ceilings & Interior Systems Construction Association<br><a href="http://www.cisca.org">www.cisca.org</a>                                       |
| CISPI | Cast Iron Soil Pipe Institute<br><a href="http://www.cispi.org">www.cispi.org</a>  |
| CLFMI | Chain Link Fence Manufacturers Institute<br><a href="http://www.chainlinkinfo.org">www.chainlinkinfo.org</a>                                   |
| CPA   | Composite Panel Association<br><a href="http://www.pbmdf.com">www.pbmdf.com</a>  |
| CRI   | Carpet and Rug Institute (The)<br><a href="http://www.carpet-rug.org">www.carpet-rug.org</a>   |
| CRRC  | Cool Roof Rating Council<br><a href="http://www.coolroofs.org">www.coolroofs.org</a>   |

|       |  |
|-------|--|
| CRSI  | Concrete Reinforcing Steel Institute<br><a href="http://www.crsi.org">www.crsi.org</a>   |
| CSA   | Canadian Standards Association<br><a href="http://www.csa.ca">www.csa.ca</a>   |
| CSA   | CSA International<br>(Formerly: IAS - International Approval Services)<br><a href="http://www.csa-international.org">www.csa-international.org</a> |
| CSI   | Construction Specifications Institute (The)<br><a href="http://www.csinet.org">www.csinet.org</a>  |
| CSSB  | Cedar Shake & Shingle Bureau<br><a href="http://www.cedarbureau.org">www.cedarbureau.org</a>   |
| CTI   | Cooling Technology Institute<br>(Formerly: Cooling Tower Institute)<br><a href="http://www.cti.org">www.cti.org</a>                                |
| CWC   | Composite Wood Council<br>(See CPA)  |
| DASMA | Door and Access Systems Manufacturers Association<br><a href="http://www.dasma.com">www.dasma.com</a>  |
| DHI   | Door and Hardware Institute<br><a href="http://www.dhi.org">www.dhi.org</a>  |
| ECA   | Electronic Components Association<br><a href="http://www.ec-central.org">www.ec-central.org</a>  |
| ECAMA | Electronic Components Assemblies & Materials Association<br>(See ECA)  |
| EIA   | Electronic Industries Alliance<br>(See TIA)  |
| EIMA  | EIFS Industry Members Association<br><a href="http://www.eima.com">www.eima.com</a>  |
| EJMA  | Expansion Joint Manufacturers Association, Inc.<br><a href="http://www.ejma.org">www.ejma.org</a>  |
| ESD   | ESD Association<br>(Electrostatic Discharge Association)<br><a href="http://www.esda.org">www.esda.org</a>   |
| ESTA  | Entertainment Services and Technology Association<br>(See PLASA)   |

|              |  |
|--------------|--|
| EVO          | Efficiency Valuation Organization<br><a href="http://www.evo-world.org">www.evo-world.org</a>  |
| FIBA         | Fédération Internationale de Basketball<br>(The International Basketball Federation)<br><a href="http://www.fiba.com">www.fiba.com</a>             |
| FIVB         | Fédération Internationale de Volleyball<br>(The International Volleyball Federation)<br><a href="http://www.fivb.org">www.fivb.org</a>             |
| FM Approvals | FM Approvals LLC<br><a href="http://www.fmglobal.com">www.fmglobal.com</a>   |
| FM Global    | FM Global<br>(Formerly: FMG - FM Global)<br><a href="http://www.fmglobal.com">www.fmglobal.com</a>   |
| FRSA         | Florida Roofing, Sheet Metal & Air Conditioning Contractors<br>Association, Inc.<br><a href="http://www.floridarroof.com">www.floridarroof.com</a> |
| FSA          | Fluid Sealing Association<br><a href="http://www.fluidsealing.com">www.fluidsealing.com</a>  |
| FSC          | Forest Stewardship Council U.S.<br><a href="http://www.fscus.org">www.fscus.org</a>  |
| GA           | Gypsum Association<br><a href="http://www.gypsum.org">www.gypsum.org</a>   |
| GANA         | Glass Association of North America<br><a href="http://www.glasswebsite.com">www.glasswebsite.com</a>   |
| GS           | Green Seal<br><a href="http://www.greenseal.org">www.greenseal.org</a>   |
| HI           | Hydraulic Institute<br><a href="http://www.pumps.org">www.pumps.org</a>  |
| HI/GAMA      | Hydronics Institute/Gas Appliance Manufacturers Association<br>(See AHRI)  |
| HMMA         | Hollow Metal Manufacturers Association<br>(See NAAMM)  |
| HPVA         | Hardwood Plywood & Veneer Association<br><a href="http://www.hpva.org">www.hpva.org</a>  |

|        |   |
|--------|---|
| HPW    | H. P. White Laboratory, Inc.<br><a href="http://www.hpwhite.com">www.hpwhite.com</a>  |
| IAPSC  | International Association of Professional Security Consultants<br><a href="http://www.iapsc.org">www.iapsc.org</a>                                |
| IAS    | International Approval Services<br>(See CSA)  |
| ICBO   | International Conference of Building Officials<br>(See ICC)   |
| ICC    | International Code Council<br><a href="http://www.iccsafe.org">www.iccsafe.org</a>  |
| ICEA   | Insulated Cable Engineers Association, Inc.<br><a href="http://www.icea.net">www.icea.net</a>   |
| ICPA   | International Cast Polymer Alliance<br><a href="http://www.icpa-hq.org">www.icpa-hq.org</a>   |
| ICRI   | International Concrete Repair Institute, Inc.<br><a href="http://www.icri.org">www.icri.org</a>   |
| IEC    | International Electrotechnical Commission<br><a href="http://www.iec.ch">www.iec.ch</a>   |
| IEEE   | Institute of Electrical and Electronics Engineers, Inc. (The)<br><a href="http://www.ieee.org">www.ieee.org</a>                                   |
| IES    | Illuminating Engineering Society<br>(Formerly: Illuminating Engineering Society of North America)<br><a href="http://www.ies.org">www.ies.org</a> |
| IESNA  | Illuminating Engineering Society of North America<br>(See IES)  |
| IENT   | Institute of Environmental Sciences and Technology<br><a href="http://www.ient.org">www.ient.org</a>  |
| IGMA   | Insulating Glass Manufacturers Alliance<br><a href="http://www.igmaonline.org">www.igmaonline.org</a>   |
| IGSHPA | International Ground Source Heat Pump Association<br><a href="http://www.igshpa.okstate.edu">www.igshpa.okstate.edu</a>                           |
| ILI    | Indiana Limestone Institute of America, Inc.<br><a href="http://www.iliai.com">www.iliai.com</a>  |



|          |  |
|----------|--|
| Intertek | Intertek Group<br>(Formerly: ETL SEMCO; Intertek Testing Service NA)<br><a href="http://www.intertek.com">www.intertek.com</a>   |
| ISA      | International Society of Automation (The)<br>(Formerly: Instrumentation, Systems, and Automation Society)<br><a href="http://www.isa.org">www.isa.org</a>                |
| ISAS     | Instrumentation, Systems, and Automation Society (The)<br>(See ISA)  |
| ISFA     | International Surface Fabricators Association<br>(Formerly: International Solid Surface Fabricators Association)<br><a href="http://www.isfanow.org">www.isfanow.org</a> |
| ISO      | International Organization for Standardization<br><a href="http://www.iso.org">www.iso.org</a>   |
| ISSFA    | International Solid Surface Fabricators Association<br>(See ISFA)  |
| ITU      | International Telecommunication Union<br><a href="http://www.itu.int/home">www.itu.int/home</a>  |
| KCMA     | Kitchen Cabinet Manufacturers Association<br><a href="http://www.kcma.org">www.kcma.org</a>  |
| LMA      | Laminating Materials Association<br>(See CPA)  |
| LPI      | Lightning Protection Institute<br><a href="http://www.lightning.org">www.lightning.org</a>   |
| MBMA     | Metal Building Manufacturers Association<br><a href="http://www.mbma.com">www.mbma.com</a>   |
| MCA      | Metal Construction Association<br><a href="http://www.metalconstruction.org">www.metalconstruction.org</a>   |
| MFMA     | Maple Flooring Manufacturers Association, Inc.<br><a href="http://www.maplefloor.org">www.maplefloor.org</a>   |
| MFMA     | Metal Framing Manufacturers Association, Inc.<br><a href="http://www.metalframingmfg.org">www.metalframingmfg.org</a>  |
| MHIA     | Material Handling Industry of America<br><a href="http://www.mhia.org">www.mhia.org</a>  |
| MIA      | Marble Institute of America<br><a href="http://www.marble-institute.com">www.marble-institute.com</a>  |

|       |   |
|-------|---|
| MMPA  | Moulding & Millwork Producers Association<br>(Formerly: Wood Moulding & Millwork Producers Association)<br><a href="http://www.wmmpa.com">www.wmmpa.com</a> |
| MPI   | Master Painters Institute<br><a href="http://www.paintinfo.com">www.paintinfo.com</a>   |
| MSS   | Manufacturers Standardization Society of The Valve and Fittings<br>Industry Inc.<br><a href="http://www.mss-hq.org">www.mss-hq.org</a>                      |
| NAAMM | National Association of Architectural Metal Manufacturers<br><a href="http://www.naamm.org">www.naamm.org</a>   |
| NACE  | NACE International<br>(National Association of Corrosion Engineers International)<br><a href="http://www.nace.org">www.nace.org</a>                         |
| NADCA | National Air Duct Cleaners Association<br><a href="http://www.nadca.com">www.nadca.com</a>  |
| NAIMA | North American Insulation Manufacturers Association<br><a href="http://www.naima.org">www.naima.org</a>   |
| NBGQA | National Building Granite Quarries Association, Inc.<br><a href="http://www.nbgqa.com">www.nbgqa.com</a>  |
| NCAA  | National Collegiate Athletic Association (The)<br><a href="http://www.ncaa.org">www.ncaa.org</a>  |
| NCMA  | National Concrete Masonry Association<br><a href="http://www.ncma.org">www.ncma.org</a>   |
| NEBB  | National Environmental Balancing Bureau<br><a href="http://www.nebb.org">www.nebb.org</a>   |
| NECA  | National Electrical Contractors Association<br><a href="http://www.necanet.org">www.necanet.org</a>   |
| NeLMA | Northeastern Lumber Manufacturers Association<br><a href="http://www.nelma.org">www.nelma.org</a>   |
| NEMA  | National Electrical Manufacturers Association<br><a href="http://www.nema.org">www.nema.org</a>   |
| NETA  | InterNational Electrical Testing Association<br><a href="http://www.netaworld.org">www.netaworld.org</a>  |

|       |   |
|-------|---|
| NFHS  | National Federation of State High School Associations<br><a href="http://www.nfhs.org">www.nfhs.org</a>             |
| NFPA  | NFPA<br>(National Fire Protection Association)<br><a href="http://www.nfpa.org">www.nfpa.org</a>                    |
| NFPA  | NFPA International<br>(See NFPA)  |
| NFRC  | National Fenestration Rating Council<br><a href="http://www.nfrc.org">www.nfrc.org</a>                              |
| NHLA  | National Hardwood Lumber Association<br><a href="http://www.nhla.com">www.nhla.com</a>                              |
| NLGA  | National Lumber Grades Authority<br><a href="http://www.nlga.org">www.nlga.org</a>                                  |
| NOFMA | National Oak Flooring Manufacturers Association<br>(See NWFA)   |
| NOMMA | National Ornamental & Miscellaneous Metals Association<br><a href="http://www.nomma.org">www.nomma.org</a>          |
| NRCA  | National Roofing Contractors Association<br><a href="http://www.nrca.net">www.nrca.net</a>                          |
| NRMCA | National Ready Mixed Concrete Association<br><a href="http://www.nrmca.org">www.nrmca.org</a>                       |
| NSF   | NSF International<br>(National Sanitation Foundation International)<br><a href="http://www.nsf.org">www.nsf.org</a> |
| NSPE  | National Society of Professional Engineers<br><a href="http://www.nspe.org">www.nspe.org</a>                        |
| NSSGA | National Stone, Sand & Gravel Association<br><a href="http://www.nssga.org">www.nssga.org</a>                       |
| NTMA  | National Terrazzo & Mosaic Association, Inc. (The)<br><a href="http://www.ntma.com">www.ntma.com</a>                |
| NWFA  | National Wood Flooring Association<br><a href="http://www.nwfa.org">www.nwfa.org</a>                                |
| PCI   | Precast/Prestressed Concrete Institute<br><a href="http://www.pci.org">www.pci.org</a>                              |

|          |   |
|----------|---|
| PDI      | Plumbing & Drainage Institute<br><a href="http://www.pdionline.org">www.pdionline.org</a>   |
| PLASA    | PLASA<br>(Formerly: ESTA - Entertainment Services and Technology Association)<br><a href="http://www.plasa.org">www.plasa.org</a> |
| RCSC     | Research Council on Structural Connections<br><a href="http://www.boltcouncil.org">www.boltcouncil.org</a>                        |
| RFCI     | Resilient Floor Covering Institute<br><a href="http://www.rfci.com">www.rfci.com</a>  |
| RIS      | Redwood Inspection Service<br><a href="http://www.redwoodinspection.com">www.redwoodinspection.com</a>                            |
| SAE      | SAE International<br>(Society of Automotive Engineers)<br><a href="http://www.sae.org">www.sae.org</a>                            |
| SBCCI    | Southern Building Code Congress International, Inc.<br>(See ICC)  |
| SCTE     | Society of Cable Telecommunications Engineers<br><a href="http://www.scte.org">www.scte.org</a>                                   |
| SDI      | Steel Deck Institute<br><a href="http://www.sdi.org">www.sdi.org</a>  |
| SDI      | Steel Door Institute<br><a href="http://www.steeldoor.org">www.steeldoor.org</a>  |
| SEFA     | Scientific Equipment and Furniture Association<br><a href="http://www.sefalabs.com">www.sefalabs.com</a>                          |
| SEI/ASCE | Structural Engineering Institute/American Society of Civil Engineers<br>(See ASCE)  |
| SIA      | Security Industry Association<br><a href="http://www.siaonline.org">www.siaonline.org</a>   |
| SJI      | Steel Joist Institute<br><a href="http://www.steeljoist.org">www.steeljoist.org</a>   |
| SMA      | Screen Manufacturers Association<br><a href="http://www.smainfo.org">www.smainfo.org</a>  |
| SMACNA   | Sheet Metal and Air Conditioning Contractors' National Association<br><a href="http://www.smacna.org">www.smacna.org</a>          |

|         |  |
|---------|--|
| SMPTE   | Society of Motion Picture and Television Engineers<br><a href="http://www.smpte.org">www.smpte.org</a>   |
| SPFA    | Spray Polyurethane Foam Alliance<br><a href="http://www.sprayfoam.org">www.sprayfoam.org</a>   |
| SPIB    | Southern Pine Inspection Bureau<br><a href="http://www.spib.org">www.spib.org</a>  |
| SPRI    | Single Ply Roofing Industry<br><a href="http://www.spri.org">www.spri.org</a>  |
| SRCC    | Solar Rating and Certification Corporation<br><a href="http://www.solar-rating.org">www.solar-rating.org</a>   |
| SSINA   | Specialty Steel Industry of North America<br><a href="http://www.ssina.com">www.ssina.com</a>  |
| SSPC    | SSPC: The Society for Protective Coatings<br><a href="http://www.sspc.org">www.sspc.org</a>  |
| STI     | Steel Tank Institute<br><a href="http://www.steeltank.com">www.steeltank.com</a>   |
| SWI     | Steel Window Institute<br><a href="http://www.steelwindows.com">www.steelwindows.com</a>   |
| SWPA    | Submersible Wastewater Pump Association<br><a href="http://www.swpa.org">www.swpa.org</a>  |
| TCA     | Tilt-Up Concrete Association<br><a href="http://www.tilt-up.org">www.tilt-up.org</a>   |
| TCNA    | Tile Council of North America, Inc.<br>(Formerly: Tile Council of America)<br><a href="http://www.tileusa.com">www.tileusa.com</a>   |
| TEMA    | Tubular Exchanger Manufacturers Association, Inc.<br><a href="http://www.tema.org">www.tema.org</a>  |
| TIA     | Telecommunications Industry Association<br>(Formerly: TIA/EIA - Telecommunications Industry<br>Association/Electronic Industries Alliance)<br><a href="http://www.tiaonline.org">www.tiaonline.org</a> |
| TIA/EIA | Telecommunications Industry Association/Electronic Industries<br>Alliance<br>(See TIA)   |

|        |  |
|--------|--|
| TMS    | The Masonry Society<br><a href="http://www.masonrysociety.org">www.masonrysociety.org</a>                                      |
| TPI    | Truss Plate Institute<br><a href="http://www.tpinst.org">www.tpinst.org</a>  |
| TPI    | Turfgrass Producers International<br><a href="http://www.turfgrasssod.org">www.turfgrasssod.org</a>                            |
| TRI    | Tile Roofing Institute<br><a href="http://www.tilerroofing.org">www.tilerroofing.org</a>                                       |
| UBC    | Uniform Building Code<br>(See ICC)   |
| UL     | Underwriters Laboratories Inc.<br><a href="http://www.ul.com">www.ul.com</a>   |
| UNI    | Uni-Bell PVC Pipe Association<br><a href="http://www.uni-bell.org">www.uni-bell.org</a>  |
| USAV   | USA Volleyball<br><a href="http://www.usavolleyball.org">www.usavolleyball.org</a>   |
| USGBC  | U.S. Green Building Council<br><a href="http://www.usgbc.org">www.usgbc.org</a>  |
| USITT  | United States Institute for Theatre Technology, Inc.<br><a href="http://www.usitt.org">www.usitt.org</a>                       |
| WASTEC | Waste Equipment Technology Association<br><a href="http://www.wastec.org">www.wastec.org</a>                                   |
| WCLIB  | West Coast Lumber Inspection Bureau<br><a href="http://www.wclib.org">www.wclib.org</a>  |
| WCMA   | Window Covering Manufacturers Association<br><a href="http://www.wcmanet.org">www.wcmanet.org</a>                              |
| WDMA   | Window & Door Manufacturers Association<br><a href="http://www.wdma.com">www.wdma.com</a>                                      |
| WI     | Woodwork Institute<br>(Formerly: WIC - Woodwork Institute of California)<br><a href="http://www.wicnet.org">www.wicnet.org</a> |
| WMMPA  | Wood Moulding & Millwork Producers Association<br>(See MMPA)   |

WSRCA      Western States Roofing Contractors Association  
www.wsrca.com

WWPA      Western Wood Products Association  
www.wwpa.org

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

DIN      Deutsches Institut für Normung e.V.  
www.din.de

IAPMO      International Association of Plumbing and Mechanical Officials  
www.iapmo.org

ICC      International Code Council  
www.iccsafe.org

ICC-ES      ICC Evaluation Service, LLC  
www.icc-es.org (562) 699-0543

- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

COE      Army Corps of Engineers  
www.usace.army.mil

CPSC      Consumer Product Safety Commission  
www.cpsc.gov

DOC      Department of Commerce  
National Institute of Standards and Technology  
www.nist.gov

DOD      Department of Defense  
http://dodssp.daps.dla.mil

DOE      Department of Energy  
www.energy.gov

EPA      Environmental Protection Agency

|      |  |
|------|--|
|      | <a href="http://www.epa.gov">www.epa.gov</a>   |
| FAA  | Federal Aviation Administration<br><a href="http://www.faa.gov">www.faa.gov</a>  |
| FG   | Federal Government Publications<br><a href="http://www.gpo.gov">www.gpo.gov</a>  |
| GSA  | General Services Administration<br><a href="http://www.gsa.gov">www.gsa.gov</a>  |
| HUD  | Department of Housing and Urban Development<br><a href="http://www.hud.gov">www.hud.gov</a>  |
| LBL  | Lawrence Berkeley National Laboratory<br>Environmental Energy Technologies Division<br><a href="http://eetd.lbl.gov">http://eetd.lbl.gov</a>     |
| OSHA | Occupational Safety & Health Administration<br><a href="http://www.osha.gov">www.osha.gov</a>  |
| SD   | Department of State<br><a href="http://www.state.gov">www.state.gov</a>  |
| TRB  | Transportation Research Board<br>National Cooperative Highway Research Program<br><a href="http://www.trb.org">www.trb.org</a>                   |
| USDA | Department of Agriculture<br>Agriculture Research Service<br>U.S. Salinity Laboratory<br><a href="http://www.ars.usda.gov">www.ars.usda.gov</a>  |
| USDA | Department of Agriculture<br>Rural Utilities Service<br><a href="http://www.usda.gov">www.usda.gov</a>   |
| USDJ | Department of Justice<br>Office of Justice Programs<br>National Institute of Justice<br><a href="http://www.ojp.usdoj.gov">www.ojp.usdoj.gov</a> |
| USP  | U.S. Pharmacopeia<br><a href="http://www.usp.org">www.usp.org</a>  |
| USPS | United States Postal Service<br><a href="http://www.usps.com">www.usps.com</a>   |



- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CFR Code of Federal Regulations  
Available from Government Printing Office  
[www.gpo.gov/fdsys](http://www.gpo.gov/fdsys)

DOD Department of Defense  
Military Specifications and Standards  
Available from Department of Defense Single Stock Point  
<http://dodssp.daps.dla.mil>

DSCC Defense Supply Center Columbus  
(See FS)

FED-STD Federal Standard  
(See FS)

FS Federal Specification  
Available from Department of Defense Single Stock Point  
<http://dodssp.daps.dla.mil>

Available from Defense Standardization Program  
[www.dsp.dla.mil](http://www.dsp.dla.mil)

Available from General Services Administration  
[www.gsa.gov](http://www.gsa.gov)

Available from National Institute of Building Sciences/Whole Building  
Design Guide  
[www.wbdg.org/ccb](http://www.wbdg.org/ccb)

MILSPEC Military Specification and Standards  
(See DOD)

USAB United States Access Board  
[www.access-board.gov](http://www.access-board.gov)

USATBCB U.S. Architectural & Transportation Barriers Compliance Board  
(See USAB)

- E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

|        |  |
|--------|--|
| CBHF   | State of California<br>Department of Consumer Affairs<br>Bureau of Electronic Appliance and Repair, Home Furnishings and<br>Thermal Insulation<br><a href="http://www.bearhfti.ca.gov">www.bearhfti.ca.gov</a> |
| CCR    | California Code of Regulations<br>Office of Administrative Law<br>California Title 24 Energy Code<br><a href="http://www.calregs.com">www.calregs.com</a>  |
| CDHS   | California Department of Health Care Services<br>(Formerly: California Department of Health Services)<br>(See CCR)   |
| CDPH   | California Department of Public Health<br>Indoor Air Quality Program<br><a href="http://www.cal-iaq.org">www.cal-iaq.org</a>   |
| CPUC   | California Public Utilities Commission<br><a href="http://www.cpuc.ca.gov">www.cpuc.ca.gov</a>   |
| SCAQMD | South Coast Air Quality Management District<br><a href="http://www.aqmd.gov">www.aqmd.gov</a>  |
| TFS    | Texas Forest Service<br>Forest Resource Development and Sustainable Forestry<br><a href="http://txforests-service.tamu.edu">http://txforests-service.tamu.edu</a>  |

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

## SECTION 01 77 00 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
  - 5. Repair of the Work.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

#### 1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
  - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
  3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
  6. Advise Owner of changeover in heat and other utilities.
  7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements, including touchup painting.
  10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

## 1.6 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
2. Submit pest-control final inspection report.

#### 1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
  1. Organize list of spaces in sequential order, starting with exterior areas first.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect
    - d. Name of Contractor.
    - e. Page number.
  4. Submit list of incomplete items in the following format:
    - a. PDF electronic file. Architect will return annotated file.

#### 1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
  1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Remove tools, construction equipment, machinery, and surplus material from Project site.

- d. Remove snow and ice to provide safe access to building.
  - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
  - f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
  - g. Sweep concrete floors broom clean in unoccupied spaces.
  - h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
  - i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - j. Remove labels that are not permanent.
  - k. Wipe surfaces of mechanical and electrical equipment[, elevator equipment,] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
  - o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
  - p. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
  - D. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
  3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 77 00



## SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.
- B. Related Requirements:
  - 1. Section 017700 "Closeout Procedures" for general closeout procedures.

### PART 2 - PRODUCTS

#### 2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding archive photographic documentation.
  - 2. Content: Types of items requiring marking include, but are not limited to, the following:

- a. Dimensional changes to Drawings.
  - b. Revisions to details shown on Drawings.
  - c. Depths of foundations below first floor.
  - d. Locations and depths of underground utilities.
  - e. Revisions to routing of piping and conduits.
  - f. Revisions to electrical circuitry.
  - g. Actual equipment locations.
  - h. Duct size and routing.
  - i. Locations of concealed internal utilities.
  - j. Changes made by Change Order or Construction Change Directive.
  - k. Changes made following Architect's written orders.
  - l. Details not on the original Contract Drawings.
  - m. Field records for variable and concealed conditions.
  - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
  2. Format: DWG, Version 2012, operating system.
  3. Format: Annotated PDF electronic file.
  4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  5. Refer instances of uncertainty to Architect for resolution.
  6. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
    - a. See Section 013300 "Submittal Procedures" for requirements related to use of Architect's digital data files.
    - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting

- an alternate, substitution, or other modification.
  - 2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
- 1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  - 2. Format: Annotated PDF electronic file.
  - 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  - 4. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor.

## 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
- 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  - 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
  - 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file paper copy.

## 2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
- 1. Give particular attention to information on concealed products and installations that

- cannot be readily identified and recorded later.
- 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
- 3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file paper copy.

- 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

## 2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file paper copy.

- 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

## PART 3 - EXECUTION

### 3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

## SECTION 03 12 00 -- CONCRETE FORMWORK

### PART 1 - GENERAL

#### 1.01 RELATED WORK

- A. Applicable provisions of Division 01 shall govern all work of this Section.

#### 1.02 WORK INCLUDED

- A. Include materials, labor, services and incidentals necessary for completion of this Section of Work.
- B. Include formwork for cast-in-place concrete as required by Concrete Contractor.
- C. Include formwork for concrete bases for equipment of mechanical and electrical divisions. Contractors for those divisions of Work shall be responsible for size, location and required inserts.
- D. Notify trades in ample time for each to install own work required in conjunction with formwork.
- E. Inserts, sleeves and other miscellaneous embedded items required by mechanical, electrical or plumbing trades shall be supplied and installed by those respective trades.
- F. Provide and install inserts, sleeves and other miscellaneous embedded items other than those required by mechanical, electrical or plumbing trades.
- G. Supply, install and maintain shoring and re-shoring related to concrete formwork.

#### 1.03 QUALITY ASSURANCE

- A. Industry Standards, Specifications and Codes:
  - 1. General:
    - a. Comply with provisions of the following codes and standards except as modified herein.
    - b. Referenced codes and standards including revisions and commentaries shall be the most currently adopted as of the date of these Contract Documents.
  - 2. American Concrete Institute (ACI)
    - a. ACI 301 Specifications for Structural Concrete for Buildings
    - b. ACI 318 Building Code Requirements for Structural Concrete
    - c. ACI 347 Guide to Formwork for Concrete
  - 3. National Forest Products Association (NFPA)
    - a. NDS National Design Specification for Wood Construction including Design Values for Wood Construction
  - 4. The Engineered Wood Association (APA)
    - a. Plywood Design Specification

#### 1.04 DESIGN CRITERIA

- A. Design forms, shores and bracing. Include factors pertaining to safety of formwork structure such as live load, dead load, weight of equipment on

formwork, concrete mix, height of concrete drop, vibration reactions and similar factors.

- B. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.

#### 1.05 ALLOWABLE TOLERANCES

- A. Flatwork true to plane: 1/4 inch in 10 feet
- B. Vertical surfaces true to plane: 1/4 inch floor to floor
- C. Formwork displacement: Maximum 1/4 inch
- D. Deviation of building dimensions indicated on drawings and position of columns, walls and partitions: 1/4 inch
- E. Deviation in cross sectional dimensions of columns, piers or beams or in thickness of slabs and walls: plus/minus 1/4 inch

### PART 2 - PRODUCTS

#### 2.01 FORM MATERIALS

- A. General: Plywood, metal-framed plywood-faced or other acceptable panel type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practical sizes to minimize number of joints. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
- B. Formed Surfaces Exposed To View: New plywood complying with U.S. Standard PS-1 Plyform Class I, B-B Concrete Form Plywood, B-Matte MDO Plywood by Simpson, 5/8 inch or 3/4 inch thick without defects, mill oiled and edge sealed or wood forms lined with 3/16 inch tempered pressed wood or 1/4 inch thick plywood B-B conforming to EXT-DFPA as large a size as possible to minimize joints.
- C. Formed Surfaces Concealed From View: Clean straight lumber dressed on face and edges, nominal 1 inch thickness or plywood 5/8 inch or 3/4 inch thick conforming to EXT-DFPA or metal forms smooth and as large a size as possible.
- D. Joist Construction: Manufactured form of steel, fiber glass or rigid plastic such as PVC complete with flange(s). Interlocking devices and caps and stiffeners, as required. System shall be free from dents, dimples, holes and unsightly patches and manufactured with side draft of 1:12 plus/minus for release. Provide adjustable shoring system to allow for camber and leveling. Reconditioned pan joist forms may be used providing they conform to these requirements.
- E. Round Column Construction: Manufactured form of fiber glass reinforced plastic as manufactured by Molded Fiber Glass Concrete Forms Company of Union City, PA (800) 458-0863 or equal. Forms to be matched, tight fitting, single piece forms with vertical seam and supplied with necessary bracing collars.

- F. Reveals and Chamfers: Wood or purpose-made plastic or high density plastic foam to achieve sharp, true lines.

## 2.02 FORMWORK ACCESSORIES

- A. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sizes as required of sufficient strength and character to maintain formwork in place while placing concrete.
- B. Form Ties:
  - 1. For Unexposed Concrete: Adjustable length removable or snap-off type which will leave holes no larger than 1 inch in diameter in face of concrete and when forms are removed no metal will be within 1 inch of finished concrete surface.
  - 2. For Exposed Concrete: Ties shall be snap-off type (break point 1 inch or more from surface) with plastic cones added to form a 1-1/4 inch diameter, 1-1/2 inch deep recess around tie, which shall be grouted flush to match adjacent concrete surface.
  - 3. No wire ties or site fabricated ties permitted.

## 2.03 CONCRETE ACCESSORIES

- A. Dovetail Anchor Slots: #305 Hohman and Barnard, Inc. or equivalent 20 gage sheet metal in Eraydo Zinc with felt strip protector.
- B. Wedge-Type Inserts: Hot rolled steel with wedge shaped holding faces designed to receive a 3/4 inch hot dipped galvanized askew head bolt. Gateway Type SL-R hot dipped galvanized or equivalent.
- C. Waterstops: PVC or SBR type, purpose made, split serrated type, center bulb.

## 2.04 FORM COATINGS

- A. Form coatings for exposed concrete shall consist of an approved non-staining form oil, lacquer or plastic. Plywood approved for reuse shall be recoated as directed by Engineer. When oil is used, excess shall be wiped off with rags. When lacquer is used, a light coating of form oil over lacquer will be permitted provided excess is wiped off. When factory-applied plastic coatings are used, follow manufacturer's instructions. Contact surface of forms shall be free of foreign matter, including dust. Form oil shall be applied to forms before reinforcing is erected. Form oil shall be of type which will not affect bonding of specified exterior finish.

## 2.05 CONSTRUCTION JOINT MATERIALS

- A. Solid Wood Lumber: Spruce-Pine-Fur (SPF) #2 or equivalent.

# PART 3 - EXECUTION

## 3.01 PREPARATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure dimensions agree with Drawings.

### 3.02 COORDINATION

- A. Coordinate work of other sections and cooperate with trades involved in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts. Do not perform work unless specifically indicated on Drawings or reviewed prior to installation.

### 3.03 FORMWORK ERECTION

- A. Erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position. Form both faces of foundations. Earth forming of footings and vertical surfaces of concrete work is not permitted.
- B. Construct forms to sizes, shapes, lines and dimensions shown on Drawings and to obtain accurate alignment, location and grades. Level and plumb work. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
- C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crust plates or wrecking plates where stripping may damage concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses and like to prevent swelling and for easy removal.
- D. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- E. At all exposed corners of concrete walls, beams, columns, slab edges and miscellaneous items not specified or indicated, provide 3/4 inch, 45 degree chamfer.
- F. Install ties so portion remaining within concrete after removal is at least 1 inch inside concrete. Remove so surrounding concrete is not disfigured and cleanout hole remains to be patched.
- G. Coat contact surfaces of forms with form-coating compound before reinforcement is placed.
- H. Thin form coating compounds only with thinning agent of type and in amount and under conditions of form coating compound manufacturer's directions. Do not allow excess form coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

### 3.04 INSERTS, EMBEDDED PARTS AND OPENINGS

- A. Plumbing, Heating and Electrical Items:



1. Premanufactured items including inserts, sleeves and other embedded items required by mechanical, electrical and plumbing trades shall be supplied, accurately located, and installed by respective trades.
  2. Site fabricated box outs for chases, sleeves and other miscellaneous openings for mechanical, electrical and plumbing trades shall be supplied and installed by Formwork Contractor.
  3. Location of mechanical, electrical and plumbing inserts, embedded parts, openings and recesses shall be coordinated with respective trades by General Contractor.
- B. Other Items:
1. Other inserts, embedded parts, box outs for openings, chases, reveals and recesses except those specifically mentioned above by mechanical, electrical or plumbing trades, shall be installed by Formwork Contractor. Special inserts, embedded parts or other special requirements needed by specific trades shall be supplied by that respective trades to Formwork Contractor for installation. General Contractor shall have overall responsibility for coordinating location of inserts, embedded parts, openings and recesses.
  2. Install concrete accessories in accordance with manufacturer's recommendations; straight, level and plumb. Ensure items are not disturbed during concrete placement.
  3. Set and build into Work, anchorage devices and other embedded items required for other work attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached. Build-in dovetail anchor slots vertically.
  4. Build-in wedge inserts indicated.

### 3.05 JOINTS AND EDGE FORMS

- A. Locate construction joints as shown on Drawings or as approved by Engineer. Form with keyway. Place perpendicular to main reinforcement. Continue reinforcement through joint, except slabs-on-grade, and locate joint so as not to affect structural integrity or appearance of structure. Includes joint between wall and footing.
- B. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units of sufficient strength to support types of screeds required. Align concrete surface to elevation of screed strips by use of strike-off templates or accepted compacting type screeds.

### 3.06 CLEANING

- A. Clean forms as erection proceeds to remove foreign matter. Remove cuttings, shavings and debris from within forms. Flush with water or use compressed air to remove remaining foreign matter. Ensure water and debris drain to exterior through clean-out ports. Retighten forms after concrete placement if required to eliminate mortar leaks.

### 3.07 FIELD QUALITY CONTROL

- A. Inspect and check completed formwork, shoring and bracing to ensure work is in accordance with formwork design and supports, fastenings, wedges, ties and parts are secured.

- B. Clean and repair surfaces of forms to be reused in Work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact form surfaces as specified for new formwork.
- C. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces. Do not use metal cover plates for repairing defects in forms for exposed concrete work.
- D. Inform Engineer when formwork is complete and has been cleaned to allow for inspection. Obtain review prior to placing concrete.
- E. For exposed to view concrete surfaces do not reuse plywood formwork.
- F. Allow Engineer to inspect each section of plywood type formwork prior to reuse.

### 3.08 METAL FLOOR DECK SHORING

- A. Shore metal floor deck at mid-span or more frequently as required to maintain a maximum deflection of 1/4 inch after placing concrete. Shore from bottom flange of supporting beams. Retain shores in place until concrete has attained 70 percent of design strength.

### 3.09 FORMWORK REMOVAL

- A. Notify Engineer and Owner's field representative prior to removing formwork, centering, shoring and reshoring.
- B. Remove forms in a manner to insure safety of structure at all times. Where entire structure is supported on shores; beam and girder sides, columns and similar vertical forms may be removed after 48 hours, providing concrete is sufficiently hard not to be injured thereby. In no case shall supporting forms or shoring be removed until members have acquired sufficient strength to support their weight and load safely. Coordinate removal with work of other trades.

- C. Remove forms according to ACI-347. However, the following schedule shall govern the minimum waiting period after placing concrete before bottom forms and shores of similar falsework supporting flexural members such as girders, beams, joists, slabs, etc. may be disturbed or stripped:

| <u>Structural Members</u>                                  | <u>Waiting Period</u> |
|--|-----------------------|
| Columns, walls and beam sides                              | 2 days                |
| Spans less than 12 foot - slabs and beam bottoms           | 7 days                |
| Spans between 12 foot and 30 foot - slabs and beam bottoms | 14 days               |
| Spans greater than 30 foot - slabs and beam bottoms        | 28 days               |

- D. Post-tensioned members may be stripped after tensioning. No re-shoring is required unless other construction loads will be imposed on P/T members.
- E. The above schedule applies to daily curing temperatures above 50 degrees. For lower daily curing temperatures, increase waiting period. In addition to above requirements, do not remove forms until concrete has attained 80 percent of minimum design strength.

- F. Re-shore removed area before removing additional adjacent formwork.
- G. Retain re-shores in place for a minimum of 14 days and concrete has attained 100 percent of minimum design strength. Retain re-shores in place until concrete construction above has attained sufficient strength to not require shoring below.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 03 21 13 -- REINFORCING STEEL

### PART 1 - GENERAL

#### 1.01 RELATED WORK

- A. Applicable provisions of Division 01 shall govern all work of this Section.

#### 1.02 WORK INCLUDED

- A. Include materials, labor, services and incidentals necessary for completion of this Section of Work.
- B. Work includes fabrication and placement of reinforcement for cast-in-place concrete including bars, welded wire fabric, ties, dowels, stirrups, supports and accessories required.
- C. (Following paragraph is typically used for Parking Ramp Repair Specifications)
- D. Work also includes the addition of supplemental reinforcing to replace bar cross section loss due to corrosion.

#### 1.03 QUALITY ASSURANCE

- A. Industry Standards, Specifications and Codes:
  - 1. General:
    - a. Comply with provisions of the following codes and standards except as modified herein.
    - b. Referenced codes and standards including revisions and commentaries shall be the most currently adopted as of the date of these contract documents.
  - 2. American Concrete Institute (ACI):
    - a. ACI 301 Specifications for Structural Concrete for Buildings
    - b. ACI 318 Building Code Requirements for Structural Concrete
    - c. ACI 315 Details and Detailing of Concrete Reinforcement
  - 3. Concrete Reinforcing Steel Institute (CRSI):
    - a. Manual of Standard Practice
    - b. Recommended Practice for Placing Reinforcing Bars
  - 4. American Society for Testing and Materials (ASTM):
    - a. Specific ASTM numbers are noted in later text.

#### 1.04 QUALIFICATIONS

- A. Acceptable Manufacturers:
  - 1. Shall be regularly engaged in the manufacture of steel bar, welded wire fabric reinforcing and mechanical splicing devices.
- B. Installer Qualifications:
  - 1. Shall have 3 years experience in installation of steel bar and welded wire fabric reinforcing.
- C. Source Quality Control:
  - 1. Mill test certificates identifying chemical and physical analysis of each load of reinforcing steel delivered if requested.

## 1.05 SUBMITTALS

- A. Submit in accordance with Division 01 requirements.
- B. Steel Properties:
  - 1. Submit certification of grade, chemical analysis and tensile properties of steel furnished if requested.
- C. Shop Drawings:
  - 1. Show sizes and dimensions for fabrication and placing of reinforcing steel and bar supports.
  - 2. Show type, size and location of accessories.
  - 3. Indicate bar schedules, stirrup spacing and diagrams of bent bars, arrangements and assemblies.
  - 4. Indicator for yield strength of bars being provided.
  - 5. Show required bar laps and call out specific lap dimensions.
  - 6. Lap splices shall develop the full strength of the bar unless lesser laps are permitted by Drawings.
- D. Manufacturer's Literature:
  - 1. Submit manufacturer's specifications, capacities and installation instructions for splice devices.

## PART 2 - PRODUCTS

### 2.01 REINFORCING STEEL

- A. Reinforcing Bars:
  - 1. Conform to ASTM A-615 "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement".
  - 2. Reinforcing bars shall be deformed, except that plain bars may be used for spirals.
  - 3. Main reinforcing bars and other bars not listed above shall be Grade 60, unless noted otherwise on Contract Documents.
- B. Welded Wire Fabric:
  - 1. Conform to ASTM A-185 "Standard Specification for Welded Steel Wire Fabric, Plain for Concrete Reinforcement".
  - 2. Welded wire fabric shall be electrically welded and 65,000 psi yield strength.

### 2.02 MECHANICAL SPLICES

- 1. Mechanical splicing devices are to be used where specifically noted on Drawings or at Contractor's option for any splice. Mechanical splicing devices shall develop 125 percent of designated yield strength of reinforcing being spliced.
- 2. Acceptable products and manufacturers are as follows:
  - a. COMPRESSION SPLICES:
    - 1) -Cadweld (compression only); Erico Products, Inc.
    - 2) -Lenton; Erico Products, Inc.
    - 3) -Speed Sleeve; Erico Products, Inc.
    - 4) -G-Lock; Gateway
    - 5) -Grip-Twist; Barsplice Products, Inc.
  - b. TENSION SPLICES:

- 1) -Cadweld (tension only); Erico Products, Inc.
  - 2) -Lenton; Erico Products, Inc.
  - 3) -Grip-Twist; Barsplice, Inc.
  - 4) -Bar-Grip System, Barsplice Products, Inc.
3. Comply with manufacturer's instructions for bar preparation and installation of splicing devices.

## 2.03 ACCESSORIES

### A. Supports For Reinforcement:

1. Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place.
2. Use wire bar type supports complying with CRSI recommendations unless otherwise indicated. Do not use wood, brick and other unacceptable materials, e.g., mortar blocks, coarse aggregates.
3. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected. For sandblasted or bush-hammered concrete provide stainless steel protected or special stainless bar supports.
4. Where indicated on Drawings, slab on grade reinforcement shall be supported on individual high chairs with sand plates for soil bearing (HCP).
5. Over waterproof membrane, use chairs with plates to prevent penetration of membrane.
6. (Following paragraph is typically used for Parking Ramp Repair Specifications)
7. In areas of concrete removal, short lengths of reinforcing bar shall be used to provide support for bars on chipped or rough concrete surfaces using similar spacing of supports.

## 2.04 FABRICATION

- A. Shop fabricate reinforcing bars to conform to required shapes and dimensions. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken materials.
- B. Reinforcement shall be bent cold unless otherwise permitted by Engineer.
- C. Unacceptable Materials:
1. Reinforcement with any of the following defects will not be permitted in Work:
    - a. Bar lengths, depths and bends exceeding specified fabrication tolerances.
    - b. Bends or kinks not indicated on Drawings or final Shop Drawings.
    - c. Bars with reduced cross-section due to excessive rusting or other cause.

## 2.05 PRODUCT DELIVERY, STORAGE AND HANDLING

### A. General:

1. Deliver reinforcement to project site in bundles marked with metal tags indicating bar size, lengths and other information corresponding to markings shown on placement drawings.
2. Handle and store materials to prevent dirt or excessive rust.

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. Examine formwork and other conditions under which concrete reinforcement is to be placed and notify Formwork Contractor of unsatisfactory conditions. Do not proceed with work until unsatisfactory conditions have been corrected in a manner to your satisfaction.

### 3.02 PLACEMENT

- A. Comply with specified codes and standards and CRSI "Recommended Practice for Placing Reinforcing Bars" for details and methods of reinforcement placement and supports and as specified.
- B. Clean reinforcement to remove loose rust and mill scale, earth, ice and other materials which reduce or impair bond with concrete.
- C. Position, support and secure reinforcement against displacement by formwork, construction or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers as required.
- D. Place reinforcement to obtain coverages for concrete protection as indicated on Contract Documents. Arrange, space and securely tie bars and bar supports together with 16 gage wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so ends are directly away from exposed concrete surfaces.
- E. (Following paragraph is typically used for Parking Ramp Repair Specifications)
- F. Exposed or additional reinforcing shall be no closer than 3/4 inch measured radially from existing concrete. Elevation of exposed or additional reinforcing shall be maintained at original height.
- G. At openings in structural slabs, provide two #4 bars top and bottom of slab at 45 degrees on all 4 corners, each bar 48 inch minimum length.
- H. At openings in concrete walls or slabs additionally provide a minimum of two #5 bars around opening.
- I. Provide two #3 bars 3 inches apart on 4 sides of floor drains in slabs.
- J. Unless permitted by Engineer, reinforcing shall not be bent after being embedded in hardened concrete.
- K. Suspend footing reinforcement in place with wires to assure proper placement. Where applicable, solid concrete bricks may be utilized to position reinforcement in spread and strip footings.
- L. Welded wire fabric shall lap one full mesh at side and end laps and must be wired together. Mesh for slabs-on-grade shall be raised at least 2 inches during concrete pour. Minimum requirement for concrete toppings and slabs-on-grade shall be WWF 6x6 - W1.4 by W1.4 unless specifically noted otherwise on Drawings. Where indicated on Drawings, slab on grade reinforcement shall be supported on individual high chairs with sand plates for soil bearing (HCP).



Supports shall be a minimum of 2 inches high and maximum spacing shall be 48 inches o.c. each way. Supports shall be tied to reinforcement.

- M. Provide sufficient number of supports and sizes as required to carry reinforcement. Maximum spacing of chairs is 48 inches on center. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

### 3.03 WELDING OF REINFORCEMENT

- A. Welding of reinforcement covered by this Section is prohibited.

### 3.04 FIELD QUALITY CONTROL

- A. Notify Engineer when reinforcing is in place so he or she may review reinforcing placement. Engineer shall have a minimum of 24 hour notice prior to placement of concrete.
- B. Tend to reinforcing at all times during concrete placement and make necessary adjustments to reinforcing which has been dislodged by concrete placement or workmen.
- C. Bar Placement Tolerances:
  - 1. 1/4 inch (plus/minus) between bars
  - 2. 1/4 inch (plus/minus) vertically for members 8 inches deep or less
  - 3. 1/2 inch (plus/minus) vertically for members over 8 inches deep and less than 2 foot deep
  - 4. 1 inch (plus/minus) vertically for members 2 foot or deeper

END OF SECTION

This Page Intentionally Left Blank

## SECTION 03 30 00 -- CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.01 RELATED REQUIREMENTS

- A. Applicable provisions of Division 01 shall govern work of this Section.

#### 1.02 WORK INCLUDED

- A. Include materials, labor, services, and incidentals necessary for completion of this section of Work.
- B. Extent of cast-in-place concrete work is shown on Drawings.
- C. Provide concrete bases for equipment of mechanical and electrical divisions. Coordinate size and location with HVAC, Plumbing, and Electrical Contractors.
- D. Notify other trades of the date for concrete placement in ample time for each to install their own work.
- E. Install anchor bolts, embedded plates, inserts and similar items furnished by other trades.

#### 1.03 NOTIFICATION

- A. Contractor shall the inspection/testing agency and Engineer at least 24 hours prior to major concrete pour.

#### 1.04 PROTECTION OF ADJACENT WORK

- A. Contractor shall be responsible to see that due care is exercised to avoid staining adjacent finished material during concrete work. Contractor, without expense, shall make such damage good to Owner.

#### 1.05 QUALITY ASSURANCES

- A. Industry Standards, Specifications and Codes:
  - 1. General:
    - a. Comply with provisions of the following codes and standards except as modified herein.
    - b. Referenced codes and standards including revisions and commentaries shall be the most currently adopted as of the date of these Contract Documents.
  - 2. American Concrete Institute (ACI):
    - a. ACI 117 Standard Specifications for Tolerances for Concrete Construction and Materials
    - b. ACI 301 Specifications for Structural Concrete
    - c. Additional ACI sections are noted in later text.
  - 3. American Society For Testing And Materials (ASTM):
    - a. Specific ASTM standards are noted in later text.

## 1.06 ALLOWABLE TOLERANCES

- A. Flatwork tolerance for random-traffic floors should be measured in accordance with ASTM E 1155.
- B. When area of slab surface within 2 feet of construction joints exceeds 25 percent of slab surface, entire surface area shall be tested, including those areas within 2 feet of construction joints.
- C. Floor tolerance measurements shall be made within 16 hours after completion of final troweling operation, and where applicable, before removal of supporting shores.
- D. Floor slabs shall conform to the following ACI F-number requirements:
  - 1. Slab-On-Grade:
    - a. Specified Overall Values - FF30/FL20
    - b. Minimum Local Values - FF15/FL10
- E. See ACI 117 for other tolerances not stated herein.

## 1.07 SUBMITTALS

- A. Submit in accordance with Division 01 requirements.
- B. Mix Designs:
  - 1. Prepare design mixtures for each class of concrete on the basis of laboratory trial mixtures or field test data, or both in accordance with ACI 301. Design mixtures shall meet the requirements listed in Table 33000-1. Submit material content per cubic yard of each class of concrete furnished including:
    - 2. Weight of cementitious materials.
    - 3. Saturated surface-dried weights of fine and coarse aggregates.
    - 4. Quantities, type and name of admixtures.
    - 5. Weight of mixing water.
- C. Submit to Engineer mix designs, certification that materials used in concrete mixtures meet ASTM and other applicable specifications, and documentation indicating proposed concrete proportions will produce an average compressive strength equal to or greater than the required compressive strength as specified in ACI 301. Obtain approval prior to placing concrete.
- D. Test Reports:
  - 1. Submit reports of concrete testing including, compressive strength, density (unit weight), air content, temperature and slump. Furnish copies to Construction Manager / General Contractor, Consulting Engineer, Concrete Supplier and Owner Representative. Test results shall be reported in writing within 2 days that tests are made.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Hydraulic Cement:

1. For normal concrete, hydraulic cement shall meet requirements of ASTM C 150, ASTM C 595, or ASTM C 1157.
  2. For air-entrained concrete, cement shall meet requirements of ASTM C 150, Type 1A Portland Cement or cement specified for normal concrete may be used with an air-entraining admixture conforming to ASTM C 260.
- B. Slag Cement:
1. Slag cement shall meet requirements of ASTM C 989.
- C. Silica Fume Cement:
1. Silica fume shall meet the requirements of ASTM C 1240.
- D. Flyash:
1. Fly ash shall meet the requirements of ASTM C 618.
- E. Aggregates:
1. Normal weight aggregate shall comply with requirements of ASTM C 33. Lightweight aggregates shall comply with requirements of ASTM C 330.
- F. Water:
1. Water used for batching concrete shall meet the requirements of ASTM C 1602.

## 2.02 ADMIXTURES

- A. No other admixtures will be allowed except those listed without Engineer's approval.
- B. Air-Entraining:
1. Shall Conform to ASTM C 260, certified by the manufacturer to be compatible with other required admixtures. The Entrained air content shall be controlled at 6½ percent for ¾" aggregate concrete and 5½ percent for 1½" aggregate concrete within limits of plus or minus 1½ percent each.
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Darex II" – W.R. Grace
    - b. "AEA 92S" - Euclid
    - c. "Catexol AE 260" – Axim Concrete Technologies
    - d. "Micro-Air" – BASF Admixtures, Inc.
    - e. "MB AE 90" – BASF Admixtures, Inc.
- C. Water Reducing:
1. Shall conform to ASTM C 494, Type A
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. "WRDA 82" – W.R. Grace
    - b. "Eucon WR-91" - Euclid
    - c. "Catexol 1000N" – Axim Concrete Technologies
    - d. "Pozzoloth 200N" – BASF Admixtures, Inc.
- D. Mid-Range Water Reducing:
1. Shall conform to ASTM C 494, Type A or Type F
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Daracem 65" – W.R. Grace

- b. "Eucon MR" - Euclid
  - c. "Catexol 3500N" – Axim Concrete Technologies
  - d. "Polyheed 997" - BASF Admixtures, Inc.
- E. High-Range Water Reducing (Super Plasticizer):
  - 1. Shall conform to ASTM C 494, Type F or Type G.
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Daracem 19" - W.R. Grace & Co.
    - b. "ADVA 100" - W.R. Grace & Co.
    - c. "Eucon 37" - Euclid
    - d. "Catexol 1000SP-MN" – Axim Concrete Technologies
    - e. "Rheobuild 1000" - BASF Admixtures, Inc.
- F. Water Reducing, Non-Chloride Accelerator:
  - 1. Shall conform to ASTM C 494, Type C or Type E.
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Polarset" - W.R. Grace & Co.
    - b. "Accelguard 80" - Euclid Chemical Co.
    - c. "Catexol 2000RHE" – Axim Concrete Technologies
    - d. "Pozzutec 20" - BASF Admixtures, Inc.
- G. Water Reducing, Retarding:
  - 1. Shall conform to ASTM C 494, Type D.
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Daratard 17" - W.R. Grace & Co.
    - b. "Eucon Retarder 100" - Euclid Chemical Co.
    - c. "Catexol 1000R" – Axim Concrete Technologies
    - d. "Pozzolith 100XR" - BASF Admixtures, Inc.

## 2.03 BONDING AGENT

- A. Shall be a poly-vinyl acetate emulsion.
- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. "Southcrete 45" – SGM
  - 2. "Euco Weld" – Euclid Chemical Company

## 2.04 RELATED MATERIALS

- A. Evaporation Retardant and Finishing Aid: Shall be "Confilm" by BASF Admixtures, Inc.
- B. Stair Nosings: Provide single component safety tread stair nosings, Type 231 on interior and exterior stairs, as manufactured by Wooster Products, Inc., Wooster, Ohio, Style AXPE by Safe-T-Metal Company or approved equal, unless indicated otherwise on Project Drawings.
- C. Waterstops: Provide flat, dumbbell type or center bulb PVC type waterstops at construction joints and other joints as indicated or otherwise detailed on Drawings. Size to suit joints. Waterstops shall be a minimum of 6 inches wide and suitable for use intended. Splices shall be made with hot splicing iron

recommended by manufacturer and shall conform to Corp or Engineers CRD-C 572.

1. Products: Subject to compliance with requirements, provide products of one of the following:
    - a. AFCO Products
    - b. The Burke Co.
    - c. Edoco Technical Products
    - d. Greenstreak Plastic Products
    - e. Harbor Town Products
    - f. W.R. Meadows
    - g. Vinylex Corp.
- D. Slab-On-Grade Poly Fiber Reinforcement Systems:
1. Synthetic Structural Fiber Reinforcement: Provide synthetic structural fibers complying with the following requirements:
    - a. Synthetic structural fibers shall meet requirements of ASTM C 1116, Paragraph 4.1.3, Type III.
    - b. Synthetic structural fibers shall be monofilament, made of polypropylene or polypropylene/polyethylene blend.
    - c. Synthetic structural fibers shall have a minimum length of 1.38 inches (35 mm) and a maximum length of 2.00 inches (51 mm).
    - d. Specific gravity between 0.90 and 0.95
    - e. Synthetic structural fibers shall have an aspect ratio (length divided by equivalent diameter of fiber) between 60 and 100.
    - f. Dosage rate:
      - 1) Slab-On-Grades: 5.0 lbs/cubic yard or the addition rate to achieve the concrete required minimum equivalent flexural strength,  $f_{e3}$  of 165 psi for a concrete with a compressive strength of 4,000 psi at 28 days. This shall be determined from the manufacturer's test data verifying fiber performance in concrete based on ASTM C1609-05, utilizing the beam size 6" x 6" x 20" ( $f_{e3}$ ) calculated using JCI-SF4 method.
    - g. Synthetic structural fibers shall be:
      - 1) Grace STRUX® 90/40 synthetic fiber
      - 2) Novomesh® 950 synthetic fiber by Propex Concrete Systems
      - 3) Tuf-Strand SF by Euclid Chemical Company
- E. Vapor Barrier: Provide vapor barrier over prepared base course. Provide manufacturer's recommended pipe boots, mastics and gusset tape. Use only materials resistant to decay when tested in accordance with ASTM E154, as follows:
1. Vapor Barrier membrane must have the following qualities;
    - a. Water Vapor Transmission Rate ASTM E 96 less than 0.008
    - b. Water Vapor Barrier ASTM E 1745 Class A
  2. Provide Stego Wrap (15 mil) Vapor Barrier by Stego Industries LLC, or approved equal (provide submittal to Engineer for approval)
- F. Non-Shrink Grout: Factory pre-mixed non-metallic grout, complying with ASTM C 1107.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Set Grout" - ChemRex
    - b. "Sonogrout" - Sonneborn
    - c. "Euco-NS" - Euclid Chemical Co.

- d. "Sealtight 588" - W.R. Meadows
  - e. "Crystex" - L&M Cons. Chemical Co.
  - f. "Sure-Grip Grout" - Dayton Superior Corp.
  - g. "Horngrout" - A.C. Horn
  - h. "Five Star Grout" - US Grout Corp.
- G. Absorptive Cover: Burlap cloth made from jute or Kenaf, weighing approximately 9 ounces per square yard, complying with AASHTO M182, Class 2.
- H. Moisture-Retaining Cover: One of the following, complying with ASTM C 171, Type 1 or 2:
- 1. Polyethylene Film
  - 2. Polyethylene Coated Burlap
- I. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound complying with ASTM C 1315 "Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete", Type I, Class A unless other type acceptable to Architect. Moisture loss not more than 0.040 gr./square cm. In 72 hours when applied at 300 sq. ft./gal. Material must be compatible with resilient flooring and carpeting adhesives. Concrete contractor shall verify compatibility before applying curing compound.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Masterseal" - Master Builders
    - b. "Kure-N-Seal" - Sonneborn
    - c. "Tri-Kote 18 Clear CRECT" - TK Products, Inc.
    - d. "Cure and Seal" - Symons Corp.
- J. Epoxy Adhesive: ASTM C 881, 2 component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Concresive LPL Liquid" - ChemRex
    - b. "Epoxite" - A.C. Horn
    - c. "Edoco 2118 Epoxy Adhesive" - Edoco Technical Prod.
    - d. "Sikadur Hi-Mod" - Sika Chemical
    - e. "Euco Epoxy 452" - Euclid Chemical Co.
    - f. "Patch and Bond Epoxy" - The Burke Co.
    - g. "Sure-Poxy" - Kaufman Products, Inc.
- K. Sealer: Where concrete floors, new or existing call for "Sealer" in Room Finish Schedule, the following material shall be applied by licensed applicator: Armorseal Floor-Plex 7100, a 2-part water-based epoxy floor coating, manufactured by the Sherwin Williams Company, or approved substitute. Furnish 5 year written guarantee.
- L. Non-slip Aggregate Finish: For landings and where otherwise noted, provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for non-slip finish with emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rust-proof, and non-glassing, and is unaffected by freezing, moisture, and cleaning materials. Submit samples for Architect's approval.



1. Products: Subject to compliance with requirements, provide one of the following:
  - a. "Frictex" - Sonneborn
  - b. "Euco-Non-Slip" - Euclid Chemical Co.
- M. Isolation Joint Filler: Shall be bituminous (1/2 inch and 1/4 inch thicknesses) conforming to ASTM D 994.
- N. Control Joint Insert: Shall be hardboard or fiberboard.
- O. Expansion Joint Filler: Shall be extruded polystyrene.
- P. Underlayment Compound: Freeflowing, self-leveling, pumpable, cement-based compound for applications from 1-1/2 inch thick to feathered edges, minimum strength of 4000 psi.
- Q. Products: Subject to compliance with requirements, provide one of the following:
  1. "Level-Right Plus" – Maxxon Great Lakes
  2. "K-15" – Ardex, Inc.
  3. "Stonecrete UL1" – Stonehard, Inc.
  4. "Thoro SLU" – Thoro System Products

## 2.05 READY MIXED CONCRETE

- A. Ready mixed concrete shall be measured, mixed and delivered according to ASTM C94, except as modified herein.
- B. Prepare design mixtures for each class of concrete on the basis of laboratory trial mixtures or field test data, or both in accordance with ACI 301. Design mixtures shall meet the requirements listed in Table 33000-1
- C. Addition of water is permitted for batches of material with insufficient slump at the job site but is limited to the lesser of; 1 gallon per cubic yard or the quantity of water indicated on the delivery ticket such that the mixing water content on approved mix design is not exceeded.
- D. Ready Mixed Concrete Delivery Tickets:
  1. Furnish 2 delivery tickets with each batch of concrete before unloading at site; 1 for Contractor and 1 for Engineer on which is printed, stamped or written the following information:
    - a. Name of ready-mix batch plant
    - b. Serial number of ticket
    - c. Date and truck number
    - d. Name of Contractor
    - e. Job name and location
    - f. Specific class or designation of concrete
    - g. Amount of concrete (cubic yards)
    - h. Time loaded or of first mixing of cement and aggregates
    - i. Type, name and amount of admixture
    - j. Type, brand and amount of cement
    - k. Total water content by producer (or W/C ratio)
    - l. Maximum size of aggregate
    - m. Weights of fine and course aggregates

E. Mix Proportioning:

1. Minimum amount of cementitious material identified in the following mix proportions shall apply for mixes for which field experience or trial mixture information required is not provided.

Table 33000-1

| <u>Class</u> | <u>Type of Construction</u>               | <u>Specified Comp Strength @ 28 Days (PSI)</u> | <u>Max. Agg. Size (In.)</u> | <u>Min. Lbs. of Cement Per C.Y.</u> | <u>Air Entrainment % +/- 1½%</u> | <u>Notes</u> |
|--------------|---|--|-----------------------------|-------------------------------------|----------------------------------|--------------|
| 1            | All Footings                              | 3000   | 1.5                         | 470                                 | None                             | (8)          |
| 3            | Walls/Piers                               | 4000   | 0.75                        | 494                                 | None                             | (8)          |
| 3a           | Exposed Walls                             | 4000   | 0.75                        | 540                                 | 6.0                              | (1, 9)       |
| 4            | Columns                                   | 4000   | 0.75                        | 494                                 | None                             | (8)          |
| 4a           | Exposed Columns                           | 4000   | 0.75                        | 564                                 | 6.0                              | (1, 9)       |
| 5            | Interior Slab on Grade                    | 4000   | 0.75                        | 540                                 | None                             | (5, 8)       |
| 6            | Exterior Slab on Grade                    | 4500   | 0.75                        | 564                                 | 6.0                              | (1,4, 9)     |
| 10           | Bond Beams                                | 3000   | 0.375                       | 470                                 | None                             | (8)          |
| 11           | Precast Topping                           | 4000   | 0.75                        | 540                                 | None                             | (8)          |
| 13           | Miscellaneous Non-Scheduled Concrete Work | 3000   | 0.75                        | 470                                 | 6.0                              | (1, 9)       |

Notes:

- (1) Air entrained concrete: Use for exterior walls, exterior slabs, walks, platforms, ramps, steps, portions of parking ramp and other concrete exposed to freezing and thawing.
- (2), (3) NOT USED
- (4) Maximum water-cementitious ratio by weight shall be 0.45.
- (5) Maximum water-cementitious ratio by weight shall be 0.50.
- (6), (7) NOT USED
- (8) A maximum of 50 percent total replacement of Portland cement with GGBFS (Ground Granulated Blast-Furnace Slag) and fly ash at a 1:1 ratio; up to 350 pounds, with a maximum 25 percent fly ash. If fly ash is used alone, limit maximum replacement to 25 percent.
- (9) A maximum of 30 percent total replacement of Portland cement with GGBFS (Ground Granulated Blast-Furnace Slag) and fly ash at a 1:1 ratio where freeze-thaw durability and exposure to deicers is likely; up to 350 pounds, with a maximum 25 percent fly ash. If fly ash is used alone, limit maximum replacement to 25 percent.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Clean all mixing and transportation equipment. Wet forms thoroughly. Remove all ice, excess water, mud and other debris from within forms and from reinforcement. Notify Engineer prior to placing in ample time for inspection of forms and reinforcing.

### 3.02 PLACEMENT OF CONCRETE

- A. Pre-Placement Inspection:
  - 1. Before placing concrete, inspect and complete formwork installation, reinforcing steel and items to be embedded or cast-in-place. Notify other Contractors to permit installation of their work; cooperate with other trades in setting such work as required. Thoroughly wet wood forms immediately before placing concrete as required where form coatings are not used. Notify inspection agency and Engineer 24 hours in advance of pouring.
- B. Placing Concrete In Forms:
  - 1. Deposit concrete in forms in horizontal layers not deeper than 18 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints. Maximum length of wall pour is 100 feet between construction joints.
  - 2. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.
  - 3. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use vibrators designed to operate with vibratory element submerged in concrete, maintaining a speed of not less than 6000 impulses per minute. Alternate methods of consolidating concrete including the use of self-consolidating concrete may be submitted to the Engineer for approval.
  - 4. Do not use vibrators to move concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- C. Placing Concrete Slabs:
  - 1. Deposit and consolidate concrete slabs in a continuous operation until placing of a panel or section is completed.
  - 2. Place interior slabs on grade using long-strip construction techniques or other approved method.
  - 3. Place suspended slabs in sections as large as practicable to complete finishing, within limits acceptable to Engineer.
  - 4. Consult with Engineer with regard to limits of single placements prior to commencing work.

5. Consolidate concrete during placing operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  6. Bring slab surfaces to correct level with a straightedge and strikeoff. Use bull floats or darbies to smooth surface, leaving it free of humps or hollows. Do not sprinkle water on plastic concrete surface. Do not disturb slab surfaces prior to beginning finishing operations. "Wet Screed" placement of slabs is not allowed.
  7. Maintain reinforcing in the proper position during concrete placement operations. mesh shall be lifted to 1/2 slab depth as pouring proceeds.
- D. Cold Weather Placing:
1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions or low temperatures in compliance with ACI 301.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt or other materials containing anti-freeze agents or chemical accelerators other than approved, non-chloride accelerating admixtures.
  4. Do not allow carbon dioxide from heating units to contact freshly placed concrete surfaces for 48 hours. Vent heaters outside of enclosure.
- E. Hot Weather Placing:
1. When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 301.
  2. Wet forms thoroughly before placing concrete.
  3. Do not use retarding admixtures without the written permission of the Engineer.

### 3.03 CONCRETE JOINTS

- A. Construction Joints:
1. Locate as directed by Engineer or as shown on Drawings. Form keyway. Place perpendicular to main reinforcement. Continue reinforcement through joint. Locate joint so as not to affect structural integrity or appearance of the structure. Includes joint between wall and footing.
- B. Isolation Joints:
1. Form with keyway with bituminous (preformed filler, 1/4 inch or 1/2 inch (as called for) thick full depth of slab-on-grade. Reinforcement is non-continuous. Locate at points of contact between slab-on-grade and vertical structural concrete.
- C. Control Joints:
1. Locate on grid lines or on lines as shown on Drawings or as directed by Engineer. Joint size shall be 1/4 inch wide by 1/5 to 1/4 of slab depth. Continue reinforcement through joint. Contractor's option to tool or use insert. Do not tool joints in slabs to receive a finished flooring material. Control joints should be made within first 24 hours of concrete pour.

### 3.04 FINISHING

- A. General:

1. Strike and level concrete. Allow to set before floating. Power float on disappearance of water sheen. Hand float areas inaccessible to power float. Applicable to flat work to obtain smooth, uniform, granular texture. Floors shall be flat and level within tolerances given in Part 1, except where drains occur or sloped floors are indicated, in which case tolerance applies to planes indicated.
- B. Troweled Finish:
  1. Power trowel to smooth finish. Hand trowel areas inaccessible to power trowel. Applicable to flatwork to receive finished flooring material.
- C. Broom Finish:
  1. Draw broom across surface after floating to form a regular, parallel pattern. Applicable to parking ramps, drives, ramps and stairs. Direction of brooming shall be perpendicular to traffic pattern.
- D. Formed Concrete:
  1. Top of concrete: Strike concrete smooth then float and trowel surface to texture comparable to formed surface.
  2. Formed Surface: As cast finish, patch holes and defects after form removal. Remove fins.
  3. Rubbed Surface: Rub with rubbing stone to remove all projections and round corners. Wet surface and brush evenly with cement grout mixture. Provide rubbed concrete surfaces in finished areas to be left to view in stairwells, where concrete is exposed to view in a finished area and wherever else a rubbed surface is called for on architectural plans.
  4. Slope exterior steps down 1/8 inch.
- E. Exterior Walks:
  1. Broom finish unless otherwise indicated. After floating, troweling and when water sheet has disappeared, brush lightly with approved steel or fiber broom not less than 18 inches wide at right angles to centerline to form a uniform roughened surface. Edge panel joints with metal tool to leave smooth border around each panel.
- F. Non-Slip Finish:
  1. Apply to exterior concrete stair treads, stair platforms, sloped walks and elsewhere as indicated. After floating, surface shall be given a "dry shake" application of crushed ceramically bonded aluminum oxide. Rate of application of such material shall be not less than 25 pounds per 100 square feet. Tamp aggregate flush with surface using a steel trowel but do not force below surface. After broadcasting and tamping, apply trowel finishing as specified.

### 3.05 CURING

- A. Comply with ACI 301.
- B. Class C Concrete Curing:
  1. Concrete surfaces not specified to receive other curing shall be liquid membrane cured per ACI 308 2.3.3. If no rate of coverage is indicated by manufacturer, apply at a uniform rate of 200 square feet per gallon. Maximum rate of coverage, even if manufacturer's recommendation indicated greater coverage, shall be 300 square feet/gallon.

- C. Formed Surfaces:
  - 1. Cure formed concrete surfaces including walls, columns, underside of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by membrane curing.
- D. Protection:
  - 1. Protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration and from damage caused by rain or flowing water. Protect finished concrete surfaces from damage by subsequent construction operations.

### 3.06 REPAIRING AND PATCHING

- A. Concrete Surface Repairs:
  - 1. Comply with ACI 301 "Specifications for Structural Concrete".
  - 2. Remove and replace, at no additional cost, concrete not formed as shown on Drawings, concrete out of alignment, surfaces beyond required tolerances or defective surfaces which cannot be properly repaired or patched, including concrete failing to meet strength requirements as determined by testing laboratory.
  - 3. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to concrete surface. Thoroughly clean, dampen with water and brush coat area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
  - 4. For exposed to view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
  - 5. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar or precast cement cone plugs secured in place with bonding agent.
  - 6. Repair concealed formed surfaces, where possible, that contain defects that affect durability of concrete. If defects cannot be repaired, remove and replace concrete.
  - 7. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope.
  - 8. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, include crazing, cracks in excess of 0.01 inch wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets and other objectionable conditions.

9. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
10. Correct low areas in unformed surfaces during, or immediately after, completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary leveling compounds may be used when acceptable to Architect.
11. Repair defective areas, except random cracks and single holes not exceeding 1 inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
12. Repair isolated random cracks and single holes not over 1 inch in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry-pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.
13. Do not use repair methods not specified above and do not perform structural repairs, except with prior written approval of Architect for method and procedure, using specified epoxy adhesive mortar.

### 3.07 QUALITY CONTROL TESTING DURING CONSTRUCTION

#### A. General:

1. Sample fresh concrete to conform to ASTM C 172.

#### B. Slump:

1. In accordance with ASTM C 143. One slump test at point of discharge from ready mix truck for each set of test cylinders taken, unless noted otherwise, with additional tests when concrete consistency seems to have changed. Slump tests, when taken, shall be conducted after site addition of superplasticizer, however a visual estimate of slump shall be recorded prior to site addition of superplasticizer to a mix. Visual slump should only be used after correlation has been established with actual slump tests. Slump test is intended primarily as a method of comparison for concrete consistency between loads.

#### C. Air Content:

1. Only for air entrained concrete, in accordance with ASTM C 231 pressure method for normal weight concrete and ASTM C 173 for lightweight concrete. One air content test for each set of strength test cylinders made unless noted otherwise. If measured air content falls outside limits specified, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, concrete will be considered to have failed to comply with Specifications. In compliance with ASTM C 94, site addition of additional air entrainment admixture is permissible until

plant adjustments have been made. For site added superplasticizer, air should only be checked after the addition of superplasticizer.

D. Concrete Temperature:

1. In accordance with ASTM C 1064 each time a set of compression test specimen is made.

E. Strength Tests:

1. Strength test for any class of concrete shall consist of 4 standard cylinders made from a composite sample secured from a single load of concrete in accordance with ASTM C 172, except when in the opinion of the Engineer, he may require additional specimens.
2. All Concrete:
  - a. Make test cylinders in accordance with ASTM C 31. Each test shall consist of a minimum of 3 cylinders.
  - b. After 24 hours, 3 cylinders to be carefully transported to testing laboratory for moist curing.
  - c. 1 laboratory cured cylinder to be tested at 7 days and 2 laboratory cured cylinders to be tested at 28 days.
3. Test results at 28 days shall be the average strength of specimens determined in accordance with ASTM C 39.
4. Strength test shall be made for: each day's pour exceeding 5 cubic yards; each class of concrete; each change of supplies or sources; and for each 150 cubic yards of concrete or fraction thereof.
5. Strength of each concrete class shall be deemed satisfactory when both of the following criteria are met:
  - a. The average of three consecutive compressive-strength tests equals or exceeds specified compressive strength.
  - b. Any individual compressive-strength test result does not fall below specified compressive strength by more than 500 psi.
6. Testing shall be performed in compliance with Division 01 provisions by an approved testing laboratory at Owner's expense, which shall submit complete reports of tests to Construction Manager / General Contractor, Concrete Supplier, Engineer and Owner's representative. Reports of compressive strength tests shall contain project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, weather at time of placement and compressive breaking strength and type of break. An individual having ACI Level 1 Technician certification shall complete testing, including test cylinder production. Site protection of test cylinders shall be made in compliance with ASTM C 31.
7. If Engineer has reason to believe cylinder strength tests are not representative of strength of concrete in place, he shall require drilled cores to be cut and tested at Contractor's expense. Coring and testing shall be in accordance with ASTM C 42 "Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete". Acceptance or rejection of concrete shall be based on cylinders made from concrete sampled at point of discharge. Impact hammer, sonoscope or other nondestructive device may be permitted, but shall not be used as the sole basis for acceptance or rejection.
8. Extent of Testing:
  - a. Class C: Air and slump tests shall be performed at a rate coinciding with strength tests. Individual test reports need not be sent to A/E.



A summary of test results shall be sent to A/E at completion of the Project. A/E shall be notified immediately by testing lab of any non-conforming tests.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 03 41 00 - PRECAST STRUCTURAL CONCRETE

### PART 1 - GENERAL

#### 1.01 SCOPE

- A. The work under this section includes the performance criteria, materials, production, and erection of structural precast and precast/prestressed structural concrete as shown on the Drawings and specified herein. This section includes elements defined as Structural Precast Concrete by the PCI 'Standard Practice Recommendations for Precast Concrete', with the exception of Hollow Core Plank. Included are the following topics:

#### PART 1 GENERAL

Scope  
Work Included  
Products Supplied but not installed  
Products installed but not supplied  
Related Work  
References  
System Description  
Submittals  
Quality Assurances

#### PART 2 PRODUCTS

Manufacturers  
Materials  
Manufactured Units  
Components  
Accessories  
Mixes  
Fabrication  
Finishes  
Source Quality Control

#### PART 3 EXECUTION

Examination  
Preparation  
Erection  
Repair/Restoration  
Field Quality Control  
Cleaning  
Protection

#### 1.02 WORK INCLUDED

- A. Include all materials, labor, services and incidentals necessary for the completion of this section of the work. The precast concrete work is indicated on the drawings and includes, but is not necessarily limited to the following:
1. Precast/Prestressed concrete inverted "T" beams
  2. Precast concrete interior columns
  3. Structural design of all precast members and connections
  4. Fees required for submittal to and approval by local code agencies

5. Steel connection plates, brackets, bolts and nuts, including embedded into supporting structure, loose and precast into members
6. Loose bearing pads
7. Grouting, anchorings, bolting and welding of members
8. Caulking of all precast member joints. Refer to Section 07 92 00

1.03 PRODUCTS SUPPLIED BUT NOT INSTALLED

- A. Includes, but not limited to the following:
1. Furnishing of column anchor bolts and required embedment hardware to be cast in to foundation by concrete contractor
  2. All required reinforcement, ties, dowels, stirrups, supports and/or accessories cast in to foundations or other site cast elements by concrete contractor

1.04 PRODUCTS INSTALLED BUT NOT SUPPLIED

- A. Sizes and locations shall be provided by trade requiring for inclusion on shop drawings. Included, but limited to the following:
1. Electrical boxes, sleeves and embedded hardware provided by Electrical Contractor
  2. Frames and sleeves for openings and embedded hardware provided by Mechanical or Plumbing Contractor
  3. Installing openings as indicated on the drawings. (Locations and sizes furnished by electrical, mechanical, or plumbing contractors.)

1.05 RELATED WORK

- A. Applicable provisions of Division 01 shall govern work of this section.
1. Cast in Place Concrete. Refer to Section 03 30 00
  2. Precast prestressed hollow core concrete planks. Refer to Section 03 41 13
  3. Precast Architectural concrete wall panels. Refer to Section 03 41 50
  4. Structural Steel Framing. Refer to section 05 12 00

1.06 REFERENCES

- A. Referenced codes and standards shall be those currently adopted by the building code having jurisdiction over the Project as of the date of these Contract Documents.
- B. Where no Building Code is enforced, referenced codes and standards shall be the most current published by the respective code bodies, unless specifically noted otherwise below.
- C. All referenced codes and standards including all revisions and commentaries shall be the most currently adopted as of the date of these contract documents unless otherwise noted.
- D. Comply with all provisions of the following codes and standards except as modified by these specifications.
- E. AMERICAN CONCRETE INSTITUTE (ACI)
1. ACI 318 - Building Code Requirements for Reinforced Concrete.
- F. AMERICAN WELDING SOCIETY (AWS)

1. AWS D1.1 - Structural Welding Code – Steel, except remove the following items from this reference:
    - a. Section 7.5.5 in its entirety, including all sub-sections
    - b. Table 7.2, Section 7.7.3, and all other references to manual welding of shear stud connectors and similar items such as deformed bar anchors. Manual welding of these items is not permitted.
  2. AWS D1.4 - Structural Welding Code - Reinforcing Steel
- G. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. A-6 - Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling
  2. A-36 - Specification for Carbon Structural Steel
  3. A-108 - Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
  4. A-123 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  5. A-153 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  6. A-185 - Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
  7. A-283 - Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
  8. A-416 - Specification for Steel Strand, Uncoated 7-Wire for Prestressed Concrete
  9. A-496 - Specification for Steel Wire, Deformed, for Concrete Reinforcement
  10. A-500 - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
  11. A-572 - Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steels
  12. A-615 - Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  13. C-33 - Specification for Concrete Aggregates
  14. C-39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens
  15. C-109 - Test Method for Compressive Strength of Hydraulic Cement Mortars
  16. C-150 - Specification for Portland Cement
  17. C-171 - Specification for Sheet Materials for Curing Concrete
  18. C-260 - Specification for Air-Entraining Admixtures for Concrete
- H. CONCRETE REINFORCING STEEL INSTITUTE (CRSI)
1. MSP - Manual of Standard Practices
- I. GENERAL BUILDING CODE
1. Wisconsin Enrolled Commercial Building Code
- J. PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)
1. MNL-116 - Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products
  2. MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products
  3. MNL-120 - Design Handbook, Precast and Prestressed Concrete
  4. MNL-122 - Architectural Precast Concrete
  5. MNL-127 - Erector's Manual Standards and Guidelines for the Erection of Precast Concrete Products
  6. MNL-132 - Erection Safety for Precast and Prestressed Concrete

7. MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction

## 1.07 SYSTEM DESCRIPTION

- A. Design Requirements
  1. Provide structural precast concrete units and connections capable of withstanding design loads as indicated on the Drawings
  2. Connections shall be detailed to ensure adequate bearing under all conditions that may occur considering effects of live load, thermal effects, internal forces (creep and shrinkage) and cumulative tolerances. Provide adjustment to accommodate misalignment of structure without permanent distortion, damage to components, wrecking of joint connection, breakage of seals and moisture penetration.

## 1.08 SUBMITTALS

- A. Submit in accordance with Division 01 requirements.
- B. Submit proposed schedule of shop drawing submittals to A/E within 2 weeks of award of contract
- C. Product Data
  1. Submit manufacturer's specifications and instructions for manufactured materials and products. Manufacturer's PCI approved testing procedures are acceptable.
- D. Shop Drawings
  1. Submit shop drawings showing complete information for fabrication and installation of precast concrete units. Indicate member dimensions and cross-section; location, size and type of reinforcement including special reinforcement and lifting devices necessary for handling and erection.
  2. Indicate type, size and thickness of bearing pads to be installed
  3. Shop drawings shall clearly indicate members at variance from those shown on the contract documents
  4. Shop drawings shall indicate loads and reactions precast components and connections transfer to foundations, walls and other supporting structural elements
  5. Provide layout, dimensions and identification of each precast unit. Indicate weld connections by AWS standard symbols (Refer to AWS D1.1 and D1.4). Detail inserts, connections and joints including accessories and construction at openings in precast units.
  6. Identify handling procedures and methods of transportation for precast members.
  7. Indicate estimated camber at initial transfer of prestressing and at time of erection for prestressed units.
  8. Prior to fabrication and during preparation of shop drawings, Contractors shall coordinate mechanical, electrical and other trades to identify size and location of required openings through or items embedded in precast units.
  9. Provide location and details of anchorage devices that are to be embedded in other construction or installed by other contractors. Provide setting diagrams, instructions and directions as required for installation.

10. Submit documentation which identifies the bearing pad manufacturer(s) being used along with current supporting literature. Pad samples shall be furnished if requested by the A/E.
  11. Submit documentation which identifies the grout type and manufacturer used along with supporting literature.
- E. Samples
1. See Section 03 41 50 for Precast Concrete Wall Panel for sample requirements).
- F. Quality Control Submittals
1. Design Data
  2. Provide manufacturer's comprehensive design calculations sealed by a Structural Engineer registered as a Professional Engineer in the State of Wisconsin. Structural Engineer shall seal all drawings required for application for building permits. Indicate design loads, including live loads, concentrated loads and dead loads in addition to structural members.
  3. Test Reports
    - a. The Precast Concrete Contractor shall at his expense, conduct concrete tests in accordance with PCI MNL-116 consisting of (as a minimum) compression and air content tests of concrete placed at the precast plant. A/E shall be allowed access to the fabrication site to observe the placing and testing operations. Copies of all tests shall be submitted to the A/E.
  4. Certificates
    - a. Precaster shall submit evidence of PCI Plant Certification within 2 weeks of award of contract
    - b. All weld operators shall possess certifications in accordance with AWS D1.1 and D1.4. Submit these certifications no later than two weeks prior to the start of erection. Certifications must be current
  5. Manufacturer's Field Reports
    - a. Design modifications may be made as necessary to meet field conditions and to ensure proper fitting of work and as acceptable to A/E. Maintain general design concept as shown without appreciably increasing or decreasing sizes of members or altering profiles and alignment as acceptable to A/E.

## 1.09 QUALITY ASSURANCE

- A. Manufacturer's Qualifications
1. Firms shall have at least 5 years of successful experience in fabrication of precast concrete units similar to units required for this project. Manufacturer shall have sufficient production capacity to produce required units without causing delay in work.
  2. Manufacturer shall be a producer member of the Prestressed Concrete Institute (PCI) and participate in its Plant Certification Program.
  3. Manufacturer and Erector shall be qualified in accordance with PCI MNL-116.
  4. When requested by the A/E, written evidence shall be submitted to show experience qualifications and adequacy of plant capacity and facilities for conformance of contract requirements.

- B. Erector's Qualifications
  - 1. Erector shall have at least 5 years of successful experience in the erection of precast structural concrete similar to the requirements of this project. Provide written documentation when requested by A/E
  - 2. Erector shall conform to the guidelines presented in PCI MNL-127.
- C. Welder's Qualifications
  - 1. All participating weld operators shall possess valid certifications in accordance with AWS D1.1 and D1.4 prior to construction.

#### 1.10 DELIVERY, STORAGE AND HANDLING

- A. Handling and Shipping
  - 1. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses, cracking or other damage.
  - 2. Lift or support units only at the points designated on the erection shop drawings.
  - 3. Place non-staining, resilient spacers of even thickness between each unit.
  - 4. Support units during shipment on non-staining, shock-absorbing material.
  - 5. Do not place units directly on ground.
  - 6. Store units to protect from contact with soil, staining and from physical damage.
  - 7. Unless otherwise specified, store units with non-staining, resilient supports located in same positions as when transported.
  - 8. Store units on firm, level and smooth surfaces.
  - 9. Place stored units so that identification marks are discernible.
- B. Acceptance at Site
  - 1. Patching shall be permitted only as approved by the A/E. Mix and place patching mixture to match color and texture of surrounding concrete and to minimize shrinkage. Patching shall be held to a minimum.
  - 2. In addition to above, in-place precast units may be rejected for any one of the following:
    - a. Exceeding the specified installation tolerances
    - b. Damaged during construction operations
    - c. Exposed-to-view surfaces which develop surface finish deficiencies
    - d. Other defects as listed in PCI MNL-116
- C. Storage and Protection
  - 1. Conduct inspections, perform testing and make repairs or replace unsatisfactory precast units as required.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Acceptable Manufacturers are:
  - 1. IPC - Des Moines, Iowa
  - 2. Spancrete - Waukesha, Wisconsin
  - 3. J.W. Peters - Burlington, Wisconsin
  - 4. Mid States Concrete Products - South Beloit, Ill
  - 5. DuKane Precast - Naperville, Ill
  - 6. ATMI Precast - Aurora, Ill



## 2.02 MATERIALS

### A. Concrete

1. Cement: For slabs, beams, columns, double tees and non-architectural wall panels shall be Gray Portland conforming to ASTM C-150, Type I or Type III.
2. Only one brand, type and manufacturer of cement shall be used for all exposed to view members
3. Silica Fume Cement: Interground silica fume cement conforming with ASTM C1240 may be used as part of or all of the cementitious materials
4. Fly Ash: Conforming with the following standards;
  - a. ASTM C-311 "Standard Method of Sampling and Testing Flyash and Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete"
  - b. ASTM C-618 "Standard Specification for Flyash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete", Class C.
5. Aggregates: Shall conform to ASTM C-33.
6. Lightweight aggregates: Shall conform to ASTM C330
7. Water: Shall be clean, fresh, free from oil, acid, organic matter or other deleterious substances.
8. Air Entrainment Admixture: Shall conform to ASTM C-260 and be certified by manufacturer to be compatible with other admixtures.
9. Curing Materials: Moisture-Retaining Cover shall conform to ASTM C-171, Type 1 or 2.
10. Liquid Membrane Curing Material shall not be permitted.
11. Calcium Chloride: Do not use calcium chloride in precast concrete and do not use admixtures containing calcium chloride.

### B. Reinforcing Steel

1. Tensioning Steel Tendons: Shall conform to ASTM A-416 Supplement, Low-Relaxation, 270 KSI minimum ultimate tensile strength.
2. Deformed Steel Bars: Shall conform to ASTM A-615, Grade 60 for non-welded conditions and ASTM A-706, Grade 60 for all welded conditions.
3. Welded Steel Wire Fabric: Shall conform to ASTM A-185 electrically welded, 65,000 PSI yield.
4. Welded Headed Studs: Headed studs shall be Nelson Type H4L or S3L, flux filled, machine welded to plates as shown on the drawings. Studs shall be made from cold drawn steel Grades C-1010 through C-1020 per ASTM A-108 and shall be machine welded per the manufacturer's recommendation.
5. Deformed Bar Concrete Anchors: Anchors shall be Nelson, flux filled, deformed bar anchors, Type D2L, machine welded to plates as shown on the drawings. Deformed wire per ASTM A-496 and shall be machine welded per the manufacturer's recommendation.

### C. Inserts and Threaded Connectors

1. Location and hardware types and sizes shall be identified on the shop drawings. Provide a minimum yield strength of 65,000 PSI. Acceptable manufacturers are Dayton/Richmond, Inc.

### D. Steel Connection Plates and Structural Shapes

1. Shall conform to ASTM A-6, A-36 or A-572.

- E. Anchor Bolts
  - 1. Shall conform to ASTM F-1554 Grade 36 with a 1" minimum diameter.
- F. Bearing Pads
  - 1. Bearing pads shall be as designed by the precast manufacturer and meet the following requirements:
    - a. Elastomeric Pads: AASHTO M251, plain, vulcanized 100 percent polychloroprene elastomer, molded to required size or cut from molded sheet 50 to 70 Shore A durometer measured in accordance with ASTM D2240, minimum tensile strength 2250 psi per ASTM D412. Acceptable types and manufacturers are Newlon by JVI, Neosorb by Voss
    - b. Random-Oriented, Fiber Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness 70 to 90 Shore A durometer. Capable of supporting a compressive stress of 3000 psi with no cracking, splitting or delaminating in the internal portions of the pad. One specimen shall be tested for each 200 pads used in the project. Shall be used at double tee stem locations. Acceptable types and manufacturers are Masticord by JVI, Fiberlast by Voss
    - c. Cotton-Duck Fabric Reinforced Elastomeric Pads: Preformed, horizontally layered cotton duck fabric bonded to an elastomer. Surface hardness of 85 to 95 Shore A durometer. Conform to Section 18.10.2 of AASHTO Specifications for Highway Bridges. Shall be used at beam and spandrel locations. Acceptable types and manufacturers are Capralon by JVI, Sorbtex by Voss
- G. Grout:
  - 1. Non-shrink grout: Premixed, packaged, non-ferrous aggregate, shrink-resistant grout containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents complying with ASTM C1107, Grade A of consistency suitable for application with a 30 minute working time. Minimum strength of grout shall be 5000psi when tested in conformance with ASTM C-109.
  - 2. Epoxy-resin grout: Two component mineral filled epoxy resin complying with requirements of ASTM C881
- H. Caulking:
  - 1. Refer to Specification Section 07 92 00.

## 2.03 CONCRETE MIXES:

- A. Batch, mix and handle concrete in accordance with ACI recommended practices. Mixes to be designed by the manufacturer. Limit use of fly ash to maximum 25 percent replacement of Portland cement by weight
  - 1. Minimum 28-day compressive strength shall be 5000 PSI unless calculations require otherwise
  - 2. Air content of concrete shall be 6 ½ % +/- 1 ½% except in columns and walls where air content of concrete shall be 6% +/- 1 ½ %
  - 3. Maximum water-cement ratio by weight for double tees, stair slabs, spandrels, inverted tee and L shaped beams shall be 0.40

## 2.04 FABRICATION

### A. Shop Assembly:

1. Maintain plant records and quality control program during production of precast units. Make records and access to plant available to A/E upon request.

### B. Forms

1. Accurately construct forms, mortar tight and of sufficient strength to withstand pressures due to concrete placement, vibration operations, temperature changes and pretensioning and detensioning operations. Coat contact surfaces of forms with release agent prior to placing reinforcement.
2. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware and secure in place during casting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement. Do not relocate bearing plates in units unless approved by A/E and General Contractor/Construction Manager.
3. Furnish loose steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast concrete units to supporting and adjacent construction
4. Cast in reglets, slots, holes and other accessories as indicated on contract drawings and shop drawings
5. Locate hoisting devices to minimize patching after erection. Hoisting devices shall not be embedded in areas exposed to view on columns, beams, and walls.
6. Cure units to develop concrete quality and to minimize appearance blemishes such as non-uniformity, staining and surface cracking. Precast units with visible cracks in the exposed faces when wet or dry and cracks anywhere which penetrate to the depth of reinforcing will not be allowed.
7. Identify each precast unit with corresponding code on erection drawings in location not visible in finished work.
8. Adequately reinforce units to resist handling, transportation and erection stresses.
9. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.
  - a. Accurately position, support, and secure reinforcement against displacement during concrete placement and consolidation operations
  - b. Locate and support reinforcement by metal or plastic chairs, runners, bolsters, spacers, hangers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place according to PCI MNL 116
  - c. Place reinforcing steel and prestressing steel to maintain required concrete cover. Increase cover requirements in accordance with ACI 318 when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete.
  - d. Direct wire tie ends away from finished, exposed concrete surfaces
  - e. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and wire tie laps. Offset laps of adjoining widths to prevent continuous laps in either direction
10. All exposed prestressing strand ends shall be painted with "Organic Zinc-Rich" protective coating. Coating applied in strict accordance with the coating manufacturer requirements.

11. General Contractor/Construction Manager shall coordinate with other trades for installation of items not supplied by precaster to be cast into the units.
12. Provide block-outs for openings larger than 10" in the design drawings. Other openings shall be located and field drilled or cut by the trade requiring them after the precast, prestressed products have been erected. Openings shall be approved by the A/E and precast fabricator before drilling or cutting.
13. Precast panels may be prestressed, reinforced with mild steel or a combination of mild steel and prestressing. Minimum clear cover for reinforcing to be 1 ½". Minimum reinforcement to be .0018 x cross-sectional area. Panels to have at least two #4 bars around perimeter of each panel.
14. All exposed corners of all concrete members including beams, columns and miscellaneous items not otherwise specified or shown on the drawings shall have a ½", 45° chamfer. Fabricator shall form recesses, chamfered joints and bevels as shown on the drawings.
15. Fabrication Tolerances
16. Fabricate in accord with PCI MNL-135

## 2.05 FINISHES:

### A. General

1. Ensure exposed-to-view finish surfaces of precast units are uniform in color and appearance as per PCI MNL-116 for precast furnished under this section.
2. Cast in all reveals, notches, and block outs as shown on the drawings.
3. Interior surfaces which are exposed to view shall have a smooth trowel finish.
4. Grade B Finish: Fill air pockets and holes larger than 1/4 inch in diameter with sand-cement paste matching color of adjacent surfaces. Fill air holes greater than 1/8 inch in width that occur in high concentration (more than one per 2 square inches). Grind smooth form offsets or fins larger than 1/8 inch. Repair surface blemishes due to holes or dents in forms. Discoloration is permitted at form joints
5. Smooth steel-trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float and trowel to a smooth, uniform finish.
6. Apply roughened surface finish in accordance with ACI 318 to precast concrete units that will receive concrete topping after installation

## 2.06 SOURCE QUALITY CONTROL

### A. Quality-Control Testing:

1. Test and inspect precast concrete according to PCI MNL 116 requirements. If using self-consolidating concrete also test and inspect according to PCI TR-6 "Interim Guidelines for the Use of Self-Consolidating Concrete."
2. Precast concrete units will be considered deficient if units fail to comply with ACI 318 (ACI 318M) strength requirements.
3. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, Precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
  - a. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
  - b. Cores will be tested in an air-dry condition or if units will be wet under service conditions, test cores, after immersion in water, in a wet condition.

- c. Strength of concrete for each series of 3 cores will be considered satisfactory if the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no single core is less than 75 percent of the 28-day design compressive strength.
- d. Test results will be made in writing on the same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following
  - 1) Project identification name and number.
  - 2) Date when tests were performed.
  - 3) Name of precast concrete fabricator.
  - 4) Name of concrete testing agency.
  - 5) Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to of concrete as placed.
- 4. Minor patching in the plant is acceptable providing structural adequacy and appearance of units is not impaired. Precast units not conforming to the approved samples or the project specifications and project drawings are subject to rejection by A/E.
- 5. Precast units with imperfections in exposed surfaces such as form joints, casting lines, irregular surfaces or edges, pits and voids, color non-uniformity, consolidation differences, exposure variations, texture non-uniformity and other improper physical appearance characteristics will not be acceptable.
- 6. Precast units which are broken, cracked, spalled, chipped, nicked, warped, stained or otherwise defective shall not be used. Visible patches or repairs when concrete is wet or dry and foreign material embedded in facing will be cause rejection
- 7. Except as specifically noted, all defective units are completely unacceptable and shall be promptly removed from the project site regardless of how damage occurred. Proof of acceptability of all precast units remains the responsibility of the General Contractor/Construction Manager. Replace unacceptable units with approved units without additional cost to the Owner.

### PART 3 - EXECUTION

- 1. Contractor shall designate and employ an individual to be responsible for OSHA job site safety requirements. Individual shall be on site at all times and have full authority to make required safety changes.

#### 3.02 EXAMINATION

- A. Verification of Conditions:
  - 1. Verify building structure, anchors, devices and openings are ready to receive the work of this section.
  - 2. Any errors in erection or misalignment of cast-in-place walls, beams or footings preventing the proper setting of precast shall be called to the attention of the A/E and Contractor responsible. These discrepancies shall be corrected before the precast is set.
  - 3. Erectors shall check both line and grade in sufficient time before erection is scheduled to permit any necessary corrections. Corrections, if any, shall be made by the General Contractor before erection begins. Proposed corrections shall be submitted to the A/E for approval.

### 3.03 PREPARATION

- A. Deliver anchorage devices that are embedded in or attached to the building structural frame or foundation before start of such work. Provide locations, setting diagrams, and templates for the proper installation of each anchorage device.

### 3.04 ERECTION

- A. Provide for erection procedures and induced loads during erection. Provide temporary structural framing, supports and bracing as determined by Precast Engineer to maintain position, stability, and alignment of units until permanent connections are completed. Maintain in place until final support is provided.
- B. Provide necessary hoisting equipment.
- C. Erect units without damage to shape or finish.
- D. Erect precast members level, plumb and square within allowable tolerances.
- E. Align and maintain uniform horizontal and vertical joints as erection progresses.
- F. Set vertical units dry, without grout attaining joint dimension with lead or plastic spacers. Grout pack base of unit.
- G. When members require adjustment beyond design or tolerance criteria, discontinue affected work until modification is approved by A/E.
- H. Install clips, hangers bearing pads and other accessories required for erection of precast concrete units to supporting members and back-up materials.
- I. Anchor units in final position by bolting, welding, grouting or as otherwise indicated on the approved erection drawings. Remove temporary shims, wedges and spacers as soon as possible after anchoring is completed.
- J. Welding: Comply with applicable AWS D1.1 and AWS D1.4 requirements for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
  - 1. Protect structural precast concrete units and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required
  - 2. Clean weld affected metal surfaces with chipping hammer followed by brushing. Then apply a minimum 0.004 inch (100 Mm) thick coat of galvanized repair paint to galvanized surfaces in conformance with ASTM A 780
- K. At bolted connections use lock washers or other acceptable means to prevent loosening of nuts.
  - 1. Where slotted connections are used, check bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connection apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench
- L. Grouting or Dry Packing Connections and Joints: Erection drawings shall indicate joints to be grouted and any critical grouting sequences. Grout open spaces at keyways, connections and joints where required or indicated. Retain grout in place

until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Fill joints completely without seepage to other surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

- M. Field cutting of precast units is not permitted without approval of the Engineer
- N. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units unless approved by Precast Engineer
- O. Erection Tolerances
  - 1. Erect structural precast concrete units level, plumb, square, true, and in alignment without exceeding the non-cumulative erection tolerances of PCI MNL 135. Level out variations between adjacent members by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to the A/E.

### 3.05 REPAIR/RESTORATION

- A. At the discretion of the A/E, repairs will be permitted provided structural adequacy, serviceability and durability of units and appearance are not impaired
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer. Remove and replace damaged structural precast concrete units that cannot be repaired.

### 3.06 FIELD QUALITY CONTROL

- A. The following tests shall be conducted at the erection site by an independent testing agency selected and paid for by the Owner.
  - 1. Weld tests including ultrasonic testing (AWS D1.1 Chapter 6 Part F), die penetration (ASTM E-165) and magnetic particle tests (ASTM E709) are to be performed upon direction of the Architect and/or the Engineer. Provide continuous field inspection for the project during welding activities.
  - 2. Grout tests are to be performed once a day whenever grouting. Each test shall consist of a minimum of three 2" cube specimens. Tests shall be made in accordance with ASTM C-109. Provide three (3) tests for the project as determined by the A/E. Submit unit prices for any additional tests which may be required.
- B. Testing agency will report test results promptly and in writing to Contractor and Engineer.
- C. Repair or remove and replace work that does not comply with specified requirements

- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements
- E. Manufacturer's Field Service:
  - 1. See PART ONE of this specification, QUALITY CONTROL SUBMITTALS, Manufacturer's Field Reports for the procedures and requirements for any field repairs and/or modifications.

### 3.07 CLEANING

- A. Clean exposed facings to remove dirt from storage and transportation.
- B. Precast Concrete Contractor shall be responsible for cleaning surfaces of stains caused as a result of their construction operations. Other Contractors who stain surfaces during their construction operations will be responsible for cleaning those surfaces. Cleaning agents shall be compatible with sealer and sealant to be applied.
- C. Clean mortar, plaster, fireproofing, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.
- D. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
- E. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
- F. Use of cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials is prohibited

### 3.08 PROTECTION

- A. Erector shall protect members from damage until erected and secured in place. General Contractor shall protect members until acceptance by Owner.
- B. Provide non-combustible shields during welding operations.

END OF SECTION



## SECTION 03 41 13 - PRECAST CONCRETE HOLLOW CORE PLANKS

### PART 1 - GENERAL

#### 1.01 SCOPE

- A. The work under this section includes the performance criteria, materials, production and erection of precast/prestressed Hollow Core Plank as shown on the Drawings and specified herein. Included are the following topics:

##### PART 1 GENERAL

Scope  
Work Included  
Products Supplied but not installed  
Products Installed but not Supplied  
Related Work  
References  
System Description  
Submittals  
Quality Assurance  
Delivery, Handling and Storage

##### PART 2

PRODUCTS  
Manufacturers  
Materials  
Concrete Mixes  
Fabrication  
Source Quality Control

##### PART 3

EXECUTION  
Examination  
Preparation  
Erection  
Repair/Restoration  
Field Quality Control  
Cleaning  
Protection

#### 1.02 WORK INCLUDED

- A. Include all materials, labor, services and incidentals necessary for the completion of this section of the work. The precast hollow core plank work is indicated on the drawings and includes, but is not necessarily limited to the following:
1. Furnishing and installation of Precast/prestressed hollow core concrete plank
  2. Structural design of precast/prestressed hollow core concrete plank
  3. Furnishing and structural design of headers required for openings through hollow core concrete planks
  4. Furnishing and structural design of embedded plates to meet criteria shown on the drawings
  5. Furnishing and design of supplemental reinforcement required for diaphragm forces shown on the drawings
  6. Loose bearing pads
  7. Fees required for submittal to and approval by local code agencies
  8. Grouting of keyways and butt joints between individual hollow core concrete planks
  9. Caulking of joints between individual precast hollow core planks. Refer to section 07 92 00,

### 1.03 PRODUCTS INSTALLED BUT NOT SUPPLIED

- A. Sizes and locations shall be provided by trade requiring for inclusion on shop drawings. Included, but limited to the following:
  - 1. Electrical boxes, sleeves and embedded hardware provided by Electrical Contractor
  - 2. Frames and sleeves for openings and embedded hardware provided by Mechanical or Plumbing Contractor
  - 3. Installing openings as indicated on the drawings. (Locations and sizes furnished by electrical, mechanical, or plumbing contractors.)

### 1.04 RELATED WORK

- A. Applicable provisions of Division 01 shall govern work of this section.
  - 1. Cast in Place Concrete. Refer to Section 03 30 00
  - 2. Precast structural concrete Refer to Section 03 41 00
  - 3. Precast concrete wall panels. Refer to Section 03 41 50
  - 4. Structural Steel Framing. Refer to section 05 12 00

### 1.05 REFERENCES

- A. Referenced codes and standards shall be those currently adopted by the building code having jurisdiction over the Project as of the date of these Contract Documents.
- B. Where no Building Code is enforced, referenced codes and standards shall be the most current published by the respective code bodies, unless specifically noted otherwise below.
- C. All referenced codes and standards including all revisions and commentaries shall be the most currently adopted as of the date of these contract documents unless otherwise noted.
- D. Comply with all provisions of the following codes and standards except as modified by these specifications
- E. AMERICAN CONCRETE INSTITUTE (ACI):
  - 1. ACI 318 Building Code Requirements for Reinforced Concrete
- F. AMERICAN WELDING SOCIETY (AWS):
  - 1. AWS D1.1 Structural Welding Code – Steel, except remove the following items from this reference: Section 7.5.5 in its entirety, including all sub-sections, Table 7.2, Section 7.7.3, and all other references to manual welding of shear stud connectors and similar items such as deformed bar anchors. Manual welding of these items is not permitted.
  - 2. AWS D1.4 Structural Welding Code - Reinforcing Steel
- G. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):
  - 1. A-6 Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use
  - 2. A-36 Specification for Structural Steel
  - 3. A-108 Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
  - 4. A-416 Specification for Uncoated Seven-Wire Stress-Relieved Steel Strand for Prestressed Concrete
  - 5. A-496 Specification for Deformed Steel Wire for Concrete Reinforcement
  - 6. A-572 Specification for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
  - 7. A-615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

8. A-706 Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement
9. C-33 Specification for Concrete Aggregates
10. C-109 Test Method for Compressive Strength of Hydraulic Cement Mortars
11. C-150 Specification for Portland Cement
12. C-171 Specification for Sheet Materials for Curing Concrete
13. C-494 Specification for Chemical Admixtures for Concrete

#### H. GENERAL BUILDING CODE

1. Wisconsin Enrolled Commercial Building Code

#### I. PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

1. MNL-116 Manual for Quality Control for Plants and Production of Precast/Prestressed Concrete Products
2. MNL-120 Design Handbook, Precast and Prestressed Concrete
3. MNL-124 Design for Fire Resistance of Precast/Prestressed Concrete
4. MNL-126 Manual for the Design of Hollow Core Slabs
5. MNL-127 Erector's Manual Standards and Guidelines for the Erection of Precast Concrete Products
6. MNL-132 Erection Safety for Precast and Prestressed Concrete
7. MNL-135 Tolerance Manual for Precast and Prestressed Concrete Construction

### 1.06 SYSTEM DESCRIPTION

#### A. Design Requirements:

1. Precast prestressed hollow core concrete slabs shall be designed and reinforced to withstand the design loads shown on the Drawings.
2. Precast prestressed hollow core concrete slabs shall be designed for fire rating indicated on the Drawings. Design in accordance with PCI MNL-124 or submit UL test report.
3. Adequately reinforce slabs to resist transporting and handling stresses.

### 1.07 SUBMITTALS

#### A. Submit in accordance with Division 01 requirements

#### B. Shop Drawings:

1. Submit shop drawings showing complete information for fabrication and installation of precast concrete units. Indicate member dimensions, weight and cross-section; location, size and type of reinforcement including special reinforcement and lifting devices necessary for handling and erection; locations of anchors, inserts and clips as required; openings and hangers.
2. Erection drawings shall indicate joints to be grouted and any critical grouting sequences.
3. Indicate type, size and thickness of bearing pads to be installed
4. Shop drawings shall clearly indicate members or details at variance from those shown on the contract documents
5. Shop drawings shall indicate loads and reactions precast components and connections transfer to foundations, walls and other supporting structural elements
6. Provide layout, dimensions and identification of each precast unit. Indicate weld connections by AWS standard symbols (Refer to AWS D1.1 and D1.4). Detail inserts, connections and joints including accessories and construction at openings in precast units.
7. Identify handling procedures and methods of transportation for precast members.
8. Indicate estimated camber at time of erection.
9. Indicate fire ratings and live load capacities.
10. Show openings larger than 8 inches. Coordinate size and location of openings required by other trades whether or not openings are shown on Structural Drawings.

- C. Wisconsin Enrolled Commercial Building Code:
  - 1. Supplier is responsible for obtaining State of Wisconsin Department of Commerce approval for products being supplied prior to fabrication.
- D. Quality Control Submittals:
  - 1. Design Data: Provide manufacturer's complete design calculations prepared by a Structural Engineer registered as a Professional Engineer in the State of Wisconsin pertinent product approval numbers given in accordance with Wisconsin Administrative Code.
  - 2. Test Reports: Precast Concrete Contractor shall, at his expense, conduct concrete tests in accordance with PCI MNL-116 consisting of (as a minimum) compression tests of concrete placed at his plant. A/E shall be allowed access to fabrication site to observe placing and testing operations. Copies of tests shall be submitted upon request of A/E.
  - 3. Certificates: Weld operators working on this Job shall possess certificates in accordance with AWS D1.1 and D1.4. Submit certifications no later than 2 weeks prior to the start of erection. Certifications must be dated within 1 year of this same date.

#### 1.08 QUALITY ASSURANCE

- A. Manufacturer's Qualifications
  - 1. Manufacturers desiring to submit bids for this work must be prequalified by the Owner.
  - 2. Firms shall have at least 5 years of successful experience in fabrication of precast concrete units similar to units required for this project. Manufacturer shall have sufficient production capacity to produce required units without causing delay in work.
  - 3. Manufacturer shall be a producer member of the Prestressed Concrete Institute (PCI) and participate in its Plant Certification Program.
  - 4. Manufacturer and Erector shall be qualified in accordance with PCI MNL-116.
  - 5. When requested by the A/E, written evidence shall be submitted to show experience qualifications and adequacy of plant capacity and facilities for conformance of contract requirements.
- B. Erector's Qualifications:
  - 1. Erector shall have at least 5 years of successful experience in erection of precast structural concrete similar to requirements of this Project.
  - 2. Erector shall conform to guidelines presented in PCI MNL-127.
  - 3. Weld operators shall possess valid certifications in accordance with AWS D1.1 prior to construction.

#### 1.09 DELIVERY, STORAGE AND HANDLING

- A. Handling and Shipping:
  - 1. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses or damage.
  - 2. Lift or support units only at points shown on erection Shop Drawings.
- B. Acceptance at Site:
  - 1. Conduct inspections, perform testing and make repairs or replace unsatisfactory precast units as required in Specifications.
  - 2. Patching shall be permitted only as approved by A/E. Mix and place patching mixture to match color and texture of surrounding concrete and to minimize shrinkage. Patching shall be held to a minimum.
  - 3. In addition to above, in-place precast units may be rejected for any one of the following:
    - a. Exceeding specified installation tolerances.
    - b. Damaged during construction operations.

- c. Exposed-to-view surfaces which develop surface finish deficiencies.
  - d. Other defects as listed in PCI MNL-116.
- C. Storage and Protection:
- 1. Place non-staining, resilient spacers of even thickness between each unit.
  - 2. Support units during shipment on non-staining, shock-absorbing material.
  - 3. Do not place units on ground.
  - 4. Store units to protect from contact with soil, staining and from physical damage.
  - 5. Store units unless otherwise specified, with non-staining, resilient supports located in same positions as when transported.
  - 6. Store units on firm, level and smooth surfaces.
  - 7. Place stored units so that identification marks are discernible.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Acceptable manufacturers are:
- 1. Spancrete - Waukesha, Wisconsin
  - 2. Flexicore/Mid-States Concrete Products – South Beloit, Illinois
  - 3. Hollowcore County Materials-Eau Claire, Wisconsin

### 2.02 MATERIALS

- A. Concrete:
- 1. Cement: Shall be Grey Portland conforming to ASTM C-150, Type I.
  - 2. Fly Ash: Conforming with the following standards;
    - a. ASTM C-311 "Standard Method of Sampling and Testing Flyash and Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete"
    - b. ASTM C-618 "Standard Specification for Flyash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete", Class C.
  - 3. Normal Weight Aggregates: Shall conform to ASTM C-33.
  - 4. Water: Shall be clean, fresh, free from oil, acid, organic matter or other deleterious substances.
  - 5. Additional Chemical Admixtures: Shall conform to ASTM C-494.
  - 6. Curing Materials: Moisture-Retaining Cover shall conform to ASTM C-171, Type 1 or 2.
  - 7. Liquid Membrane Curing Material shall not be permitted.
  - 8. Evaporation Retardant and Finishing Aid: Shall be "Con-Film" by Master Builders.
  - 9. Calcium Chloride: Admixtures containing calcium chloride are prohibited.
  - 10. Sealant: Provide sealant as specified in Section 07 92 00.
- B. Reinforcing Steel:
- 1. Tensioning Steel Tendons: Shall conform to ASTM A-416 Supplement, Low-Relaxation, 270 KSI minimum ultimate tensile strength.
  - 2. Deformed Steel Bars: Shall conform to ASTM A-615, Grade 60 for non-welded conditions and ASTM A-706, Grade 60 for welded connections.
  - 3. Welded Headed Studs: Headed anchors shall be Nelson Type H4L or S3L, flux filled, welded to plates as shown on Drawings. Studs shall be made from cold drawn steel Grades C-1010 through C-1020 per ASTM A-108 and shall be welded per manufacturer's recommendation.
  - 4. Deformed Bar Anchors: Concrete anchors shall be Nelson, flux filled, deformed bar anchors, Type D2L, welded to plates as shown on Drawings. Studs shall be

made from ASTM A-108 cold worked, deformed wire per ASTM A-496 and shall be welded per manufacturer's recommendation.

- C. Steel Connection Plates, Structural Shapes and Headers:
  - 1. Shall conform to ASTM A-6 and A-36 or A-572.
- D. Bearing Strips:
  - 1. Shop Drawings shall identify strip type, size, thickness and location.
  - 2. Plastic: 1/8 inch thick multi-monomer plastic strips shall be non-leaching and support construction loads with no visible overall expansion. Acceptable type and manufacturers are Korolath by Dayton/Superior Concrete Accessories, Shimmers by JVI
- E. Grout:
  - 1. Shall conform to ASTM C-109. Use 1 part Portland Cement to 3 parts fine sand with water sufficient for placement and hydration.
- F. Caulking:
  - 1. Refer to Specification Section 07 92 00.

## 2.03 CONCRETE MIXES

- A. Batch, mix and handle concrete in accordance with ACI recommended practices. Mixes to be designed by manufacturer.
- B. Minimum 28-day compressive strength shall be 5000 PSI unless calculations require otherwise. Minimum release strength shall be 3500 PSI.

## 2.04 FABRICATION

- A. Shop Assembly:
  - 1. Fabricate precast hollow core concrete slabs in accordance with PCI MNL-116.
  - 2. Precast concrete slabs shall be wet or steam cured and shall be clean, smooth and straight without fins, broken edges or structural defects prior to delivery.
  - 3. Openings 8 inch in diameter or larger shall be provided by this section.
  - 4. Include cast-in weld plates where required for anchorage or lateral bracing to structural steel members.
  - 5. Cooperate with other trades for installation of items to be cast-in precast hollow core slabs. Notify General Contractor/Construction Manager of items not received in ample time so as not to delay work.
- B. Shop Finishing:
  - 1. Standard Finish:
    - a. Normal plant run finish produced in forms that impart a smooth finish to concrete.
    - b. Precast units to receive composite topping shall have contact surface sufficiently roughened to develop composite action

## 2.05 SOURCE QUALITY CONTROL

- A. Quality-Control Testing:
  - 1. Test and inspect precast concrete according to PCI MNL 116 requirements.
  - 2. Testing:
    - a. If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, Precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.

- b. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Engineer
- c. Cores will be tested in an air-dry condition or if units will be wet under service conditions, test cores, after immersion in water, in a wet condition.
- d. Strength of concrete for each series of 3 cores will be considered satisfactory if the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no single core is less than 75 percent of the 28-day design compressive strength
- e. Test results will be made in writing on the same day that tests are performed, with copies to Engineer, Contractor, and precast concrete fabricator. Test reports will include the following:
  - 1) Project identification name and number.
  - 2) Date when tests were performed.
  - 3) Name of precast concrete fabricator.
  - 4) Name of concrete testing agency.
  - 5) Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

B. Defective Work:

- 1. Structural precast concrete units that do not comply with acceptability requirements in PCI MNL 116, including concrete strength and manufacturing tolerances are unacceptable. Chipped, spalled or cracked units may be repaired. Replace unacceptable units with precast concrete units that comply with requirements.

### PART 3 - EXECUTION

- A. Contractor shall designate and employ an individual to be responsible for OSHA job site safety requirements. Individual shall be on site at all times and have full authority to make required safety changes.

#### 3.02 EXAMINATION

- A. Examine supporting structure or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.
- B. Errors in erection or misalignment of walls, beams or footings preventing proper setting of precast plank shall be called to the attention of Contractor responsible and to the attention of A/E and shall be corrected before precast is set.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.03 PREPARATION

- A. Deliver anchorage devices that are embedded in or attached to the building structural frame or foundation before start of such work. Provide locations, setting diagrams, and templates for the proper installation of each anchorage device.

#### 3.04 ERECTION

- A. Precast members shall be erected in accordance with manufacturer's drawings and installation instructions unless specified otherwise.

- B. Install precast units in a sequence to avoid eccentric loading of supporting structural elements. Where supporting members are loaded eccentrically, provide shoring or bracing to resist eccentric loading.
- C. Install bearing strips at bearing surfaces.
- D. Provide headers of cast-in-place concrete or structural steel shapes for openings larger than 1 slab width in accordance with slab manufacturer's recommendations.
- E. Units shall be erected tight and at right angles to bearing surfaces unless shown otherwise. Minimum bearing lengths shall be 2-1/2 inches on steel, 3 inches on concrete and 3-1/2 inches on masonry. Align and level precast concrete slabs using steel or plastic shims.
- F. Members shall be accurately placed and adjusted for proper alignment and elevation prior to being permanently secured. After a member is placed which requires welding to a support or adjacent member it shall be welded prior to placement of adjacent members.
- G. Clean joints before grouting.
- H. Grout open spaces at keyways, connections and joints where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Fill joints completely without seepage to other surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Remove grout that seeped through to underside below before grout hardens.
- I. Trowel top of grout joints on roofs smooth to prevent any unevenness that might interfere with placing of, or cause damage, to insulation and roofing. Provide transitions due to different surface levels not steeper than 1 to 12.
- J. Provide suitable end cap or dam in voids as required to restrict flow of grout or topping into voids or where indicated on the Drawings.
- K. Where slab voids are to be used as electrical raceways or mechanical ducts provide a taped butt joint at end of slabs, making sure the voids are aligned.
- L. Necessary shimming, bolting, welding of weld plates, grouting and calking shall be performed by this Contractor.
- M. Do not cut reinforcing or prestressing steel without written approval of manufacturer and as acceptable to A/E.
- N. Apply sealant uniformly to plank joints on underside of precast concrete units exposed to view.

### 3.05 CONSTRUCTION

- A. Interface with Other Products:
  - 1. Openings less than 8 inches in diameter shall be drilled in the field by trades involved. Openings proposed for field drilling shall be approved in writing by the precast manufacturer prior to drilling operation. Tools used to drill such openings shall be power operated, carborundum or diamond tipped drills approved for use by the precast manufacturer. Damage incurred during drilling operations will be repaired as directed by A/E and paid for by trade involved.
  - 2. In no event will drilling be allowed in locations which will endanger capacity of members.
  - 3. Unless otherwise shown on the Drawings, items to be fastened to precast members shall be by internally threaded flush mounted drop in expansion anchors (Powers



Mini Drop-In or Hilti HDI-P Drop-in Anchor) provided maximum penetration of the anchor is less than 1 inch and anchor locations and use are approved in writing by the precast manufacturer. In no case will use of powder actuated fasteners be allowed.

B. Erection Tolerances

1. Erect precast concrete hollow core units level, plumb, square, true, and in alignment without exceeding the non-cumulative erection tolerances of PCI MNL 135. Level out variations between adjacent members by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to the A/E.

3.06 REPAIR AND RESTORATION

- A. Repairs will be permitted provided structural adequacy, serviceability and durability of units and appearance are not impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet
- C. Remove and replace damaged structural precast concrete units that cannot be repaired

3.07 FIELD QUALITY CONTROL

A. Testing:

1. Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections. Field welds will be subject to visual inspections and non-destructive testing in accordance with ASTM E 165 or ASTM E 709. Testing agency will report test results promptly and in writing to Contractor and Architect. Repair or remove and replace work that does not comply with specified requirements.
2. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.
3. If the Engineer has reason to believe that the strength of in place precast units is inadequate, he may order additional in place testing to establish adequacy of precast units.

3.08 CLEANING

- A. Clean exposed facings to remove dirt from storage and transportation.
- B. Clean mortar, plaster, fireproofing, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
- D. Use of cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials is prohibited
- E. Remove surplus materials and rubbish and leave work neat and fully finished.

3.09 PROTECTION

- A. Installer shall protect members from damage until erected and secured in place. General Contractor/Construction Manager shall protect members until acceptance by Owner.

- B. Installer shall be responsible to see that due care is exercised to avoid staining or damaging adjacent finished material during installation of precast units. Contractor, without expense to owner, shall repair and make such damage
- C. Provide non-combustible shields during welding operations.

END OF SECTION

## SECTION 03 41 50 - PRECAST CONCRETE PANELS

### PART 1 - GENERAL

#### 1.01 SCOPE

- A. This section includes the performance criteria, materials, production and erection of architectural precast concrete for the entire project. The work performed under this section includes all labor, material, equipment, related services and supervision required for the manufacture and erection of the architectural precast concrete work shown on the contract drawings.

PART 1      GENERAL  
Scope  
Work Included  
Products Supplied But Not Installed  
Products Installed But Not Supplied  
Related Work  
References  
System Description  
Submittals  
Quality Control Submittals  
Quality Assurance  
Product Delivery, Storage and Handling

PART 2      PRODUCTS  
Materials  
Fabrication  
Finishes  
Source Quality Control

PART 3      EXECUTION  
Examination  
Preparation  
Erection  
Repairs/Restoration  
Field Quality Control  
Cleaning  
Protection

#### 1.02 WORK INCLUDED

- A. Include materials, labor, services and incidentals necessary for completion of this Section of Work.
- B. Include design, manufacturing and installation of precast concrete panels including reinforcement, grouting, anchorage plates and welding. Units to be fabricated by manufacturer and approved by A/E.
- C. Precast supplier to provide connection hardware. Items embedded in concrete to be supplied in a timely manner to General Contractor along with placing drawings. Include fastenings and anchoring devices for connecting units to structural frame and inserts or bolts cast in panels, bolts for inserts, shims, dowels

and miscellaneous accessories required to fasten units properly. Furnish and install anchors for fastening units to masonry, concrete and structural steel. Include mortar and joint materials.

#### 1.03 PRODUCTS SUPPLIED BUT NOT INSTALLED

- A. Includes, but limited to the following:
  - 1. Furnishing embedded anchors and required embedded hardware to be cast in to foundation by concrete contractor
  - 2. All required reinforcement, ties, dowels, stirrups and/or accessories to be cast in to foundations, slabs or other site cast elements by concrete contractor

#### 1.04 PRODUCTS INSTALLED BUT NOT SUPPLIED

- A. Includes, but limited to the following:
  - 1. Electrical boxes, sleeves and embedded hardware provided by electrical contractor
  - 2. Frames and sleeves for openings and embedded hardware provided by Mechanical or Plumbing Contractor
  - 3. Installing openings as indicated on the drawings (Locations and sizes furnished by electrical, plumbing or mechanical contractors).

#### 1.05 RELATED WORK

- A. Cast-in-Place Concrete. Refer to Section 03 30 00 for placing connection anchors in concrete.
- B. Precast Structural Concrete. Refer to Section 03 41 00
- C. Precast Concrete Hollow Core Plank. Refer to Section 03 41 13
- D. Unit Masonry Assemblies Refer to Section 04 20 00
- E. Structural Steel Refer to Section 05 12 00
- F. Joint Sealants Refer to Section 07 92 00
- G. Applicable provisions of Division 01 shall govern work of this Section.

#### 1.06 REFERENCES

- A. Comply with provisions of the following codes and standards except as modified herein.
- B. Referenced codes and standards including revisions and commentaries shall be the most currently adopted as of the date of these Contract Documents.
- C. American Concrete Institute (ACI):
  - 1. ACI 318 Building Code Requirements for Reinforced Concrete.
- D. Concrete Reinforcing Steel Institute (CRSI):
  - 1. MSP - Manual of Standard Practices
- E. Prestressed Concrete Institute (PCI):

1. MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products
  2. MNL-120 - Design Handbook, Precast and Prestressed Concrete
  3. MNL-122 - Architectural Precast Concrete
  4. MNL-124 - Design for Fire Resistance of Precast Prestressed Concrete
  5. MNL-127 - Standards and Guidelines for the Erection of Precast Concrete Products
  6. MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction
  7. MNL-137 - Recommended Practice for the Erection of Precast Concrete
- F. American Welding Society (AWS):
1. AWS D1.1 - Structural Welding Code – Steel, except remove the following items from this reference:
    - a. Section 7.5.5 in its entirety, including all sub-sections
    - b. Table 7.2, Section 7.7.3, and all other references to manual welding of shear stud connectors and similar items such as deformed bar anchors. Manual welding of these items is not permitted.
  2. AWS D1.4 Structural Welding Code - Reinforcing Steel
- G. American Society for Testing and Materials (ASTM):
1. A-6 - Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use
  2. A-36 - Specification for Structural Steel
  3. A-108 - Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
  4. A-153 - Specification for Zinc Coatings (Hot-Galvanized) on Iron and Steel Hardware
  5. A-185 - Specification for Welded Steel Wire Fabric for Concrete Reinforcement
  6. A-283 - Specification for Low and Intermediate Strength Carbon Steel Plates
  7. A-416 - Specification for Uncoated Seven-Wire Stress-Relieved Steel Strand for Prestressed Concrete
  8. A-497 - Specification for Deformed Steel Wire for Concrete Reinforcement
  9. A-572 - Specification for High-Strength Low-Alloy Columbian-Vanadium Steels of Structural Quality
  10. A-615 - Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  11. C-33 - Specification for Concrete Aggregates
  12. C-109 - Test Method for Compressive Strength of Hydraulic Cement Mortars
  13. C-150 - Specification for Portland Cement
  14. C-171 - Specification for Sheet Materials for Curing Concrete
  15. C-260 - Specification for Air-Entraining Admixtures for Concrete
  16. C-494 - Specification for Chemical Admixtures for Concrete

## 1.07 SYSTEM DESCRIPTION

- A. Design Requirements:
1. Panels shall conform to work shown on Drawings. It shall be precaster's responsibility to provide comprehensive engineering to accomplish Work based on criteria specified.

2. Coordinate with trade requiring openings 6 inches in diameter or larger for preparation of manufacturer's design, shop drawings and fabrication.
3. Panels may be reinforced with mild steel or a combination of mild steel and prestressing steel. Minimum reinforcement to be .0018 times cross-sectional area. Minimum clear cover for reinforcing to be 1 inches unless requirements of ACI 318 dictates a greater value. As a minimum, panels to have at least two #4 bars around perimeter of each panel.
4. Panels to be designed for in place loads (handling, transportation and construction loads). Panels to be designed for wind load requirements indicated on drawings. Include additional loads per applicable building codes. Load combinations to be per ACI 318. Panels to be designed crack-free per PCI MNL-120. Account for temperature and shrinkage stresses per PCI MNL-120.
5. Connection details and joints between panels to accommodate temperature and shrinkage effects of panels without damage. Panels to be supported vertically by foundations below and attached to structural frame at 2 points only for lateral support. Connections shall be designed for forces parallel to and perpendicular to panel due to lateral (wind and seismic) forces indicated on drawings.
6. Give proper consideration to fire rating requirements.

#### 1.08 SUBMITTALS

- A. Submit in accordance with Division 01 requirements.
- B. Submit proposed schedule of shop drawing submittals to A/E within 2 weeks of award of contract
- C. Shop Drawings:
  1. Submit shop drawings showing complete information for fabricating and installing precast concrete panels. Indicate member dimensions and cross-section including face and back up mix locations and thicknesses; location size and type of reinforcement including special reinforcement and lifting devices necessary for handling and erection.
  2. Provide erection drawings, connection details and hardware placement drawings. Shop Drawings shall indicate panel locations and sizes. Include details showing relationship between precast panels and adjacent materials.
  3. Welded connections to be indicated following AWS standard guidelines. Indicate sizes and details of joints and fastening devices. Locations and details of anchorage devices that are to be embedded in other construction are to be clearly shown.
  4. Contractor shall take measurements and be solely responsible for proper fitting of his work to conditions in the field.
  5. Fabrication of units prior to approval of Shop Drawings by A/E is solely the responsibility of the Contractor.
- D. Samples:
  1. Furnish sample units of proposed fabricated units to A/E for approval. Submit samples in the following sizes and order for approval: 12 inch by 12 inch, 48 inch by 48 inch and full size (to be used on the project).
  2. Samples shall show color and texture, hardness and workmanship and shall be prepared from materials which Contractor proposes to use.
- E. Qualification Data:

1. When requested by A/E, provide data verifying qualifications:
  - a. Manufacturers Qualification: Listing of projects where precast concrete panels similar to this project have been successfully provided and valid evidence of PCI Plant Certification
  - b. Erectors qualifications: Current Certificate of Compliance with PCI Field Qualification Program in category S2. Provide listing of projects similar to this project successfully erected within the last 5 years
  - c. Welders qualifications: Provide welders qualification certificates
  
- F. Material Certificates:
  1. Submit certificates signed by manufacturer certifying each of the following complies with requirements
    - a. Cement
    - b. Reinforcing materials including prestressing tendons
    - c. Admixtures
    - d. Bearing pads
    - e. Structural steel shapes and hollow structural sections
    - f. Insulation
  
- G. Quality Control Submittals
  1. Design Data:
    - a. Design members under direct supervision of a Structural Engineer experienced in design of precast concrete units, registered as a Professional Engineer in the State of Wisconsin. Submit mix designs, certifications and laboratory test results as required.
  2. Test Reports:
    - a. Precast Concrete Contractor shall, at his expense, conduct concrete tests in accordance with PCI MNL-117 consisting of (as a minimum) compression and air content tests of plant placed concrete provided for this project. A/E shall be allowed access to fabrication site to observe placing and testing operations. Copies of tests shall be submitted to A/E upon request.
  3. Certificates:
    - a. Welder Certifications: prepared for review when specifically requested by A/E; document that welders performing work on Project are currently certified for welds and welding positions utilized in accordance with AWS D1.1 and D1.4. Include welder and welding operator qualification test records, certifications, and Wisconsin Department of Commerce certification card for welders and welding operators.

## 1.09 QUALITY ASSURANCE

- A. Manufacturer's Qualifications
  1. Precast panel manufacturer shall have a minimum of 5 years of experience and shall submit a list of 6 projects where concrete wall panels similar to this project have been successfully supplied.
  2. Precast panel manufacturer shall be a participating member of the PCI Plant Certification Program, certified as a Group A, Category A1
  3. Manufacturer's plant shall have capacity and equipment to produce units of sizes and configuration required without delaying the project.
  
- B. Erector's Qualifications:

1. Erector shall have at least 5 years of successful experience in the erection of precast concrete similar to requirements of this project.
  2. Erector shall be qualified in accordance with the PCI Field Qualification Program and conform to guidelines presented in PCI MNL-127.
- C. Welder's Qualifications:
1. Participating weld operators shall possess valid certifications in accordance with AWS D1.1 and D1.4 prior to construction.
- D. Mockups:
1. After sample approval but before production fabrication of precast concrete wall panels, construct full sized mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Mockup to be representative of the finished work in all respects including glass, aluminum framing, sealants and architectural precast concrete complete with all anchors, connections, flashings, and joint fillers as accepted on the final shop drawings. Build mockups to comply with the following requirements, using materials indicated for the completed work:
    - a. Build mockups in the location and of the size indicated or, if not indicated, as directed by A/E.
    - b. Notify A/E in advance of dates and times when mockups will be constructed.
    - c. Obtain A/E's approval of mockups before starting fabrication.
    - d. In presence of A/E, damage part of an exposed face for each finish, color, and texture, and demonstrate materials and techniques proposed for repairs to match adjacent undamaged surfaces.
    - e. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
    - f. Approved mockups may become part of the completed Work if undamaged at the time of Substantial Completion.

#### 1.10 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Handling and Shipping:
1. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, staining, and to prevent cracking, distortion, warping or other physical damage
  2. Store units, unless otherwise specified, with non-staining, resilient supports
  3. Place non-staining resilient spacers of even thickness between each unit.
  4. Support units during shipment on non-staining shock absorbing material.
  5. Handle, transport and store units in a position and manner consistent with their shape and design in order to prevent cracking, distortion, warping, staining and other physical damage.
  6. Lift or support units only at points shown on erection Shop Drawings.
  7. Deliver work of this Section to Job Site in such quantities and at such times to assure continuity of construction.
- B. Acceptance at Site:
1. Conduct inspections, perform testing and make repairs or replace unsatisfactory precast units as required.
  2. Patching shall be permitted only as approved by A/E. Mix and place patching mixture to match color and texture of surrounding concrete and to minimize shrinkage. Patching shall be held to a minimum.



3. Faces shall be clean and straight with no projecting fins, broken edges or defects. Warped or otherwise defective units will be rejected.
  4. In addition to above, in-place precast units may be rejected for any one of the following:
    - a. Exceeding specified installation tolerances.
    - b. Damaged during construction operations.
    - c. Exposed-to-view surfaces which develop surface finish deficiencies.
    - d. Other defects as listed in PCI MNL-117.
- C. Storage and Protection:
1. Support units during shipment on nonstaining shock-absorbing material.
  2. Do not place units on ground.
  3. Store units to protect from contact with soil staining and from physical damage.
  4. Store units unless otherwise specified with non-staining, resilient supports located in same positions as when transported.
  5. Store units on firm, level and smooth surfaces.
  6. Place stored units so that identification marks are discernible.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Mold Materials
1. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; non-reactive with concrete and suitable for producing required finishes.
  2. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete
- B. Concrete Materials
1. Cement:
    - a. Shall be non-staining, White (OR Grey) Portland conforming to ASTM C-150, Type I OR Type III. Surfaces exposed to view shall use cement of the same type, brand and mill source. Manufacturer as approved by A/E based on approved sample.
    - b. Standard grey Portland cement may be used for non-exposed backup concrete
- C. Aggregates:
1. Shall conform to ASTM C-33. Maximum size aggregate shall be that which will pass 3/4 inch screen free from iron sulfates and of material required to provide finish on approved submittal sample.
    - a. Face mix aggregates shall be hard, durable and free of materials that react with cement or cause staining. Gradation shall be selected to match reference sample
- D. Sand:
1. Shall be clean, washed, natural sand, free of impurities, color as required by approved samples conforming to ASTM C-33.

- E. Water:
  - 1. Shall be clean, fresh, free from oil, acid, organic matter or other deleterious substances.
- F. Admixtures:
  - 1. Admixtures containing calcium chloride or more than 0.15 percent chloride ions or other salts by weight of admixture are prohibited
- G. Air Entrainment Admixture:
  - 1. Shall conform to ASTM C260 and be compatible with other provided admixtures.
- H. Water Reducing:
  - 1. Shall conform to ASTM C494, Type A and be compatible with other provided admixtures
- I. Mid-Range Water Reducing:
  - 1. Shall conform to ASTM C494, Type A and be compatible with other provided admixtures
- J. High-Range Water Reducing (Super Plasticizer):
  - 1. Shall conform to ASTM C494, Type F or Type G and be compatible with other provided admixtures
- K. Water Reducing, Non-Chloride Accelerator:
  - 1. Shall conform to ASTM C494, Type C or Type E and be compatible with other provided admixtures
- L. Water Reducing, Retarding:
  - 1. Shall conform to ASTM C494, Type D and be compatible with other provided admixtures
- M. Additional Chemical Admixtures:
  - 1. Shall conform to ASTM C-494.
- N. Plasticizing Admixture:
  - 1. Shall conform to ASTM C1017 Type I or II and be compatible with other provided admixtures
- O. Curing Materials:
  - 1. Moisture-Retaining Cover shall conform to ASTM C-171, Type 1 or 2.
- P. Liquid Membrane Curing Material:
  - 1. Not permitted.
- Q. Evaporation Retardant and Finishing Aid:
  - 1. Shall be "Con-Film" by Master Builders.
- R. Calcium Chloride:
  - 1. Use of admixtures containing calcium chloride is prohibited
- S. Tensioning Steel Tendons:
  - 1. Shall conform to ASTM A-416 Supplement, Low-Relaxation, 270 KSI minimum ultimate tensile strength.

- T. Deformed Steel Bars:
1. Shall conform to ASTM A-615, Grade 60 for non-welded conditions and ASTM A-706, Grade 60 for welded connections.
  2. Reinforcement to be galvanized shall be galvanized after fabrication and shall conform to ASTM A767-Class II. Damaged areas shall be repaired with zinc rich repair paint in accordance with ASTM A780
- U. Welded Wire Fabric:
1. Shall be provided in flat sheets only, conforming to ASTM A185, fabricated from electrically welded steel drawn wire providing a minimum 65,000 PSI yield.
- V. Welded Headed Studs:
1. Headed anchors shall be Nelson Type H4L or S3L, flux-filled, welded to plates as shown on Drawings. Studs shall be made from cold drawn steel Grades C1010 through C1020 per ASTM A108 and shall be welded per manufacturer's recommendation.
- W. Deformed Bar Anchors:
1. Concrete anchors shall be Nelson, flux-filled, deformed bar anchors, Type D2L, welded to plates as shown on Drawings. Studs shall be made from ASTM A108 cold worked, deformed wire per ASTM A496 and shall be welded per manufacturer's recommendation.
- X. Supports For Reinforcement:
1. Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected. For sandblasted or bush-hammered concrete provide stainless steel protected or stainless steel bar supports.
- Y. Steel Connection Plates and Structural Shapes
1. Steel plates and structural shapes: Shall conform to ASTM A6 and A36 or A572.
  2. Carbon Steel Structural Tubing: Shall conform to ASTM A500 Grade B
  3. Surfaces of non-galvanized steel items, except those embedded in concrete shall be prepared according to SSPC-SP1 and SSPC-SP3 and primed with lead and chromate free rust-inhibitive primer
  4. Steel items indicated as stainless steel shall conform to ASTM A666 Type 304
- Z. Insulated Panel Accessories
1. Expanded-Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation complying with ASTM C578 formed by expansion of polystyrene base resin.
  2. Wythe Connectors: As selected by precaster to connect wythes of precast concrete panels
- AA. Anchors, Dowels and Fastening Devices:
1. Anchor bolts shall conform to ASTM F1554 Grade 36
  2. Stainless steel bolts and studs shall conform to ASTM F593, type 304 or 316.

3. Parts of anchoring devices exposed to weather or as noted on drawings shall be stainless steel conforming to ASTM A666, Type 304
4. Plastic Shims: Locations shall be shown on the shop drawings. Acceptable type and manufacturers are Korolath by Dayton-Superior, Shimmers by JVI.

BB. Bearing Pads:

1. Elastomeric Pads to be 50 to 70 Durometer, AASHTO (neoprene). Protect against pad "walkout" and consider non-parallel bearing surfaces, lift-off rotation, etc.

CC. Grout:

1. Non-shrink grout: Premixed, packaged, non-ferrous aggregate, shrink-resistant grout containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents complying with ASTM C1107, Grade A of consistency suitable for application with a 30 minute working time. Minimum strength of grout shall be 5000psi when tested in conformance with ASTM C109.
2. Epoxy-resin grout: Two component mineral filled epoxy resin complying with requirements of ASTM C881

DD. Caulking:

1. Refer to Specification Section 07 92 00.

EE. Concrete Mixes:

1. Batch, mix and handle concrete in accordance with PCI recommended practices. Mixes to be designed by the manufacturer and meet the following criteria:
  - a. Minimum 28-day compressive strength shall be 5000 PSI unless calculations greater
  - b. Air content of concrete shall be 6 ½ % +/- 1 ½%
  - c. Water absorption limited to maximum 6 percent by weight or 14 percent by volume when tested in accordance with PCI MNL 117

## 2.02 FABRICATION

A. Shop Assembly:

1. Maintain plant records and quality control program during production of precast units. Make records and access to plant available to A/E upon request.
2. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement and vibration operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
3. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
  - a. Form joints are not permitted on faces exposed to view in the finished work
  - b. Edge and Corner Treatment: Uniformly chamfered.
4. Units must be factory cast for required quality control. See Architectural and Structural Drawings for various conditions, openings, offsets.

## 2.03 FINISHES:

### A. General

1. Ensure exposed-to-view finish surfaces of precast units are uniform in color and appearance as per PCI MNL-117 for precast furnished under this section.
2. Cast in all reveals, notches, and block outs as shown on the drawings.
3. Smooth steel-trowel finish unformed surfaces, including but not necessarily limited to interior surfaces which are exposed to view. Consolidate concrete, bring to proper level with straightedge, float and trowel to a smooth, uniform finish.
4. Commercial Architectural (CA) Finishes: Member faces shall be free of joint marks, grain, or other obvious defects. Corners, including false joints shall be uniform, straight and sharp. Finish exposed-face surfaces of structural precast concrete units to match approved sample panels and mockups, and as follows:
  - a. Acid-etched / lightly exposed aggregate finish (50/50 blend white and gray concrete): Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections and insulation from acid attack.
5. Other Finishes (Underside of Canopy Panels):
  - a. Grade A Finish: Repair and/or fill all surface blemishes with the exception of air holes 1/16 inch in width or smaller and form marks where the surface deviation is less than 1/16 inch. Float-apply a neat cement-paste coating to exposed surfaces. Rub dried paste coat with burlap to remove loose particles. Discoloration is permitted at form joints. Grind smooth all form joints.
6. Units shall be of size shown, cast in forms of rigid construction and shall be straight, square and true, designed for close control of dimensions and details as shown on Shop Drawings.
7. Cure units in forms for a minimum of 20 hours before stripping. Temperatures during this period shall be no less than 70 degrees F and units shall be kept moist in accordance with ASTM C171. Additional curing as required to produce units meeting design requirements or requirements of this Specification. Curing may be accelerated with radiant heating or steam as long as concrete temperature does not exceed 180 degrees F.
8. Provide inserts for units as shown or required. Cast into panels anchors required for frames or other items required in wall. Verify insert size and location with trade furnishing unit to be anchored in panel. Cast or cut in holes for dowels and lugs.
9. Exercise care to keep reinforcing free of form oil and other substances harmful to bond.

### B. Insulated Panel Casting

1. Cast and screed supported wythe over mold.
2. Place insulation boards, abutting edges and ends of adjacent boards. Insert wythe connectors through insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.
3. Cast and screed top wythe to meet required finish.

### C. Fabrication Tolerances

1. Fabricate in accord with PCI MNL-135

## 2.04 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete also test and inspect according to PCI Interim Guidelines for the Use of Self-Consolidating Concrete
- B. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 (ACI 318M) requirements for concrete strength
- C. Inspection:
  - 1. A/E shall have free access to inspect material, equipment, fabrication, curing and storing units.
  - 2. Mark units for identification and record day of casting of each unit.
  - 3. Testing: If there is evidence that the concrete strength of precast concrete panels may be deficient or may not comply with ACI 318 (ACI 318M) requirements, Precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C42M.
    - a. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by A/E
    - b. Cores will be tested in an air-dry condition.
    - c. Strength of concrete for each series of 3 cores will be considered satisfactory if the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no single core is less than 75 percent of the 28-day design compressive strength.
    - d. Test results will be made in writing on the same day that tests are performed, with copies to A/E, Contractor, and precast concrete fabricator. Test reports will include the following:
      - 1) Project identification name and number.
      - 2) Date when tests were performed.
      - 3) Name of precast concrete fabricator.
      - 4) Name of concrete testing agency.
      - 5) Identification letter, name, and type of precast concrete units or units represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
  - 4. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mix that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
  - 5. Defective Work: Architectural precast concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range are unacceptable. Chipped, spalled or cracked units may be repaired, if repaired units match the visual mock-up. The A/E reserves the right to reject any unit if it does not match the accepted samples and visual mock-up. Replace unacceptable units with precast concrete units that comply with requirements.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

#### A. Verification of Conditions:

1. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Errors in erection or misalignment of walls, beams or footings preventing proper setting of precast panels shall be called to the attention of Contractor responsible and to the attention of A/E and shall be corrected before precast is set. Proceed with installation only after unsatisfactory conditions have been corrected.
2. Do not install precast concrete units until supporting cast-in place concrete building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is structurally ready to receive loads from precast.

### 3.02 PREPARATION

- A. Deliver anchorage devices that are embedded in or attached to the building structural frame or foundation before start of such work. Provide locations, setting diagrams, and templates for the proper installation of each anchorage device
- B. Contractor shall review installation procedures and coordinate with other work and other contractors whose work will or may be affected by work of this Section.

### 3.03 ERECTION

#### A. General:

1. Precast members shall be erected in accordance with manufacturer's drawings and installation instructions unless specified otherwise.
2. No warped, cracked, broken, spalled, stained or otherwise defective units shall be set or erected.
3. Lift, transport and erect members so initial allowable transfer fiber stresses are not exceeded.
4. Install loose clips, hangers, bearing pads and other accessories required for connecting architectural precast concrete units to supporting members and backup materials
5. Install precast concrete panels plumb, level, square true to line and dimensions, in position assigned and secure to work as shown on approved erection and Shop Drawings. Carefully plumb panels. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed. Erection work shall be carried out under direct supervision of representative of manufacturer. Joint clearances shall be as shown on Drawings.
6. Accurately align and place elements using temporary bracing designed by Precast Engineer until permanent connections are made.
7. Members which require welding to a support or adjacent member shall be welded prior to placement of adjacent members. Protect precast concrete panels and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required.

8. Welds not specified shall be continuous fillet welds, using not less than the minimum fillet as specified by AWS.
9. Clean weld affected metal surfaces with chipping hammer followed by brushing then reprime damaged painted surfaces in accordance with manufacturer's recommendations.
10. Visually inspect all welds critical to precast connections. Visually check all welds for completion and remove, re-weld or repair all defective welds, if services of AWS-certified welding inspector are not furnished by Owner
11. At bolted connections, use lock washers, tack welding, or other acceptable means to prevent loosening of nuts after final adjustment.
12. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connection apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
13. Grouted Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
14. Necessary shimming, bolting, welding of weld plates, grouting and calking shall be performed by this Contractor.

B. Erection Tolerances:

1. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL-127.

3.04 REPAIRS/RESTORATION

- A. Repair damaged architectural precast concrete units if permitted by A/E. The A/E reserves the right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- D. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.05 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.
- B. Field welds will be subject to visual inspections and non-destructive testing in accordance with ASTM E165 or ASTM E709.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.



- D. Repair or remove and replace work that does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.06 CLEANING

- A. Clean all surfaces of precast concrete to be exposed to view, as necessary, prior to shipping.
- B. Clean mortar, plaster, fireproofing, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
  - 1. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
  - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

3.07 PROTECTION

- A. Installer shall protect members from damage until erected and secured in place. General Contractor shall protect members until acceptance by Owner.
- B. Employ adequate means to protect facing of units from staining, injury or damage during handling and erection until such time as work has been inspected and accepted by the Owner.
- C. Provide non-combustible shields during welding operations.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 04 20 00 - UNIT MASONRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Concrete masonry units.
  - 2. Mortar and grout.
  - 3. Steel reinforcing bars.
  - 4. Miscellaneous masonry accessories.

#### 1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection:

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

#### 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

#### 1.8 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
  - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  2. Protect sills, ledges, and projections from mortar droppings.
  3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## PART 2 - PRODUCTS

### 2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

### 2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  2. Provide bullnose units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.
1. Density Classification: Normal weight.

## 2.3 AND LINTELS

- A. General: Provide one of the following:
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.
- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

## 2.4 MORTAR AND GROUT MATERIALS

- A. Aggregate for Mortar: ASTM C 144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  - 2. For joints less than **1/4 inch** thick, use aggregate graded with 100 percent passing the **No. 16** sieve.
- B. Aggregate for Grout: ASTM C 404.
- C. Water: Potable.

## 2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, **Grade 60**.
- B. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

## 2.6 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

## 2.7 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Use mortar unless otherwise indicated.
  - 3. For exterior masonry, use mortar.

4. For reinforced masonry, use mortar.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.
1. For masonry below grade or in contact with earth, use Type S.
  2. For reinforced masonry, use Type S.
- C. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi
  3. Provide grout with a slump of 10 to 11 inches as measured according to ASTM C 143/C 143M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
  2. Verify that foundations are within tolerances specified.
  3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
  - 1. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

### 3.3 TOLERANCES

#### A. Dimensions and Locations of Elements:

- 1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
- 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
- 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

#### B. Lines and Levels:

- 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
- 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
- 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- 5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
- 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

### 3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.



- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond ; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
  - 1. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
  - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
  - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
  - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Set trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
  2. Allow cleaned surfaces to dry before setting.
  3. Wet joint surfaces thoroughly before applying mortar.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

### 3.6 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
1. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
- C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

### 3.7 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

2. Limit height of vertical grout pours to not more than 60 inches.

### 3.8 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  2. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  4. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

### 3.9 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  1. Crush masonry waste to less than 4 inches in each dimension.
  2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
  3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 20 00

This Page Intentionally Left Blank

## SECTION 05 12 00 -- STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.01 SCOPE

- A. The work under this section includes labor, materials, equipment and services to provide structural steel framing installation as shown on the Drawings and specified herein.
- B. Structural steel includes elements defined as “Structural Steel” by the AISC “Code of Standard Practice for Steel Buildings and Bridges” plus field installed shear stud connectors and dowel bar anchors. Included are the following topics:

PART 1        GENERAL  
                 Scope  
                 Related Work  
                 References  
                 Submittals  
                 Quality Assurance  
                 Delivery, Storage and Handling

PART 2        PRODUCTS  
                 Materials  
                 Design Criteria  
                 Fabrication  
                 Finishes  
                 Source Quality Control

PART 3        EXECUTION  
                 Examination  
                 Preparation  
                 Erection  
                 Field Quality Control

#### 1.02 RELATED WORK

- A. Applicable provisions of Division 01 shall govern work of this Section.
- B. Section 03 10 00 – Concrete Forming
- C. Section 05 50 00 – Metal Fabrications
- D. Items furnished by this section but not installed:
  - 1. Anchor rods
  - 2. Anchor rod templates

#### 1.03 REFERENCES

- A. Referenced codes and standards shall be those currently adopted by the Building Code enforced by the jurisdiction in which the Project is located, as of the date of these Contract Documents. Where no Building Code is enforced, referenced codes and standards shall be the most current published by the respective code bodies, unless noted otherwise.

- B. General Building Code
  - 1. Wisconsin Commercial Building Code
- C. American Institute of Steel Construction (AISC)
  - 1. Specification for Structural Steel Buildings (2005)
  - 2. Code of Standard Practice for Steel Buildings and Bridges (2005)
  - 3. Manual of Steel Construction, Thirteenth Edition
- D. Research Council on Structural Connections (RCSC)
  - 1. Specification for Structural Joints Using ASTM A325 or A490 Bolts
- E. American Society for Testing and Materials (ASTM)
  - 1. ASTM standards as noted in short form throughout the specification text.
- F. American Welding Society (AWS):
  - 1. AWS D1.1/D1.1M:2006 Structural Welding Code – Steel, except remove the following items from this reference:
    - a. Section 7.5.5 in its entirety, including sub-sections, Table 7.2,
    - b. Section 7.7.3, and other references to manual welding of shear stud connectors, headed concrete anchors, deformed bar concrete anchors and threaded base studs. Manual welding of these items is not permitted.
  - 2. AWS D1.3/D1.3M:2007 Structural Welding Code - Sheet Steel
  - 3. AWS A5.1/A5.1M:2006 Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
  - 4. AWS A5.5/A5.5M:2006 Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding
  - 5. AWS A5.17/A5.17M-97 Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding
  - 6. AWS A5.23/A5.23M:1997 Specification for Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding
- G. Steel Structures Painting Council (SSPC):
  - 1. SSPC-SP 1 Solvent Cleaning
  - 2. SSPC-SP 2 Hand Tool Cleaning
  - 3. SSPC-SP 3 Power Tool Cleaning
  - 4. SSPC-SP 6 Commercial Blast Cleaning
  - 5. SSPC-SP 10 Near-White Blast Cleaning

#### 1.04 SUBMITTALS

- A. Provide submittals in accordance with the requirements of Division 1.
- B. Product Data: prepared for review and approval; include manufacturer's data for each product where specific request is made in Part 2.
- C. Shop Drawings: prepared for review and approval; include erection plans, setting diagrams, erection details showing work required for structural steel framing installation, type of steel, details of structural members including cuts, connections, camber, holes, and other modifications to base member. Indicate type, size and length of bolts, distinguishing between shop and field bolts, and identifying pre-tensioned (PT) and slip-critical (SC) bolts. Indicate welds with

standard AWS symbols, distinguishing between shop and field welds, and identifying size, length and type of weld.

- D. Calculations: prepared for review; include design calculations for connections where design loads are noted on drawings or specifications. Calculations shall be signed and sealed by the supervising professional.
- E. Test reports: prepared for review; include the result and evaluation of tests performed by a qualified testing agency on structural steel framing elements and on shear stud connectors and dowel bar anchors; applies to tests performed at the fabrication plant and at the jobsite.
- F. Fabricator certifications: prepared for review; include documentation certifying that the structural steel fabricator meets the quality assurance requirements.
- G. Erector certifications: prepared for review; include documentation certifying that the structural steel erector meets the quality assurance requirements.
- H. Mill certifications of structural steel shapes: prepared for review when specifically requested by A/E; show heat number, chemical and mechanical properties and material test results of structural steel delivered to site.
- I. Mill certifications of high strength bolts, nuts and washers: prepared for review when specifically requested by A/E; show chemical and mechanical properties, and bolt test results for fasteners delivered to site.
- J. Welder Certifications: prepared for review when specifically requested by A/E; document that structural steel welders performing work on Project are currently certified for welds and welding positions utilized. Include welder and welding operator qualification test records, certifications, and Wisconsin Department of Commerce certification card for welders and welding operators.
- K. Weld Procedure Qualification Test Records: prepared for review; document record of successful testing by welder performing welds for joints used which are not pre-qualified by AISC.

#### 1.05 QUALITY ASSURANCE

- A. Comply with the applicable provisions of the specifications, standards and documents listed under References, except as modified by this specification.
- B. Fabricator: Fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- C. Erector: Erector shall have a minimum of 5 years of continuous experience in the erection of similar structures.
- D. Testing Agency: independent testing laboratory retained by the Owner and continuously engaged in testing similar that required for the Project for a period of not less than five years.
- E. Supervising professional for calculations: a currently licensed Professional Engineer in state in which Project is located.
- F. Welding: Qualify personnel and procedures according to AWS D1.1.

## 1.06 DELIVERY, STORAGE AND HANDLING

- A. Handle materials to avoid bending, twisting or other damage resulting in permanent deformation.
- B. Store materials to permit easy access for inspection and identification.
- C. Store members off ground by placing on appropriate supports and spacers, adjusted to permit water to drain from parts. Protect members from rust, corrosion and deterioration.
- D. Store fasteners in a protected place. Clean and re-lubricate bolts and nuts that become dirty or dry before use.
- E. Do not store material on completed or partially completed structure in a manner that might overload, cause distortion, or damage material or supporting structure.

## PART 2 - PRODUCTS

### 2.01 OWNER FURNISHED PRODUCTS

### 2.02 MATERIALS

- A. Rolled steel plates, shapes and bars, tubular steel and bolts shall be of domestic manufacture and be clean and free of rust and pitting.
- B. W and WT shapes: ASTM A992/A992M-06a ( $F_y = 50$  ksi)
- C. M, S, and HP shapes: ASTM A36/A36M-05
- D. Channels: ASTM A36/A36M-05
- E. Angles: ASTM A36/A36M-05
- F. HSS square and rectangular shapes: ASTM A500-03a Grade B
- G. HSS round shapes: ASTM A500-03a, Grade B.
- H. Pipe: ASTM A53/A53M-06a, Type E or S, Grade B
- I. Plates: ASTM A36/A36M-05
- J. High Strength Bolts: ASTM A325-06, Type 1 or ASTM A490-06, Type 1, as detailed
- K. Anchor Bolts: ASTM F1554-04, Grade 36, Thread Class 2A
- L. Standard Washers: ASTM F436-04, Type 1
- M. Plate Washers: ASTM A36/A36M-05
- N. Nuts for High Strength Bolts: ASTM A563, Type 1, Grade DH
- O. Nuts for Anchor Bolts: ASTM A563, Type 1, Grade A



- P. Twist-Off Tension-control Bolt Assemblies: ASTM F1852-05, Type 1, or ASTM F2280-06, Type 1 as detailed.
- Q. Threaded Rods: ASTM A36/36M-05
- R. Welding Electrodes: E70XX
- S. Shear connectors: manufactured from cold drawn bar stock conforming to ASTM A108-03e1, Grades 1010 through 1020. Finished connectors shall meet the requirements of AWS D1.1, Type B. Acceptable products - S3L Shear Connector as manufactured by TRW Nelson
- T. Headed concrete anchors: manufactured from cold drawn bar stock conforming to ASTM A108-03e1, Grades 1010 through 1020. Finished connectors shall meet the requirements of AWS D1.1, Type A or Type B. Acceptable products - H4L Shear Connector as manufactured by TRW Nelson
- U. Deformed bar concrete anchors: ASTM A496/496M-05. Acceptable products - D2L as manufactured by TRW Nelson
- V. Threaded base studs: manufactured from cold drawn bar stock conforming to ASTM A108-03e1, Grades 1010 through 1020. Finished connectors shall meet the requirements of AWS D1.1, Type A. Acceptable products - CPL or CFP Threaded Base Studs as manufactured by TRW Nelson
- W. Expansion slide bearings: Self-lubricating bearing elements 3/32 inch thick composed of 100 percent virgin PTFE and reinforcing aggregates factory bonded with epoxy to appropriate backing materials. Principle constituent of reinforcing aggregate shall be ground glass fibers. Acceptable products: Fluorogold Slide Bearings as manufactured by Seismic Energy Products
- X. Primer paint:
  - 1. Acceptable products for interior exposure:
    - a. Series 88HS, Gray, as manufactured by Tnemec Inc.
    - b. Interlac 393, Gray, as manufactured by International Paint Company
    - c. Equal approved rust-inhibitive primer
  - 2. Acceptable products for exterior exposure:
    - a. Series 90-97 Tnemec-Zinc as manufactured by Tnemec Inc.
    - b. Interzinc 52 Zinc-Rich Epoxy Primer, Gray, as manufactured by International Paint Company
- Y. Grout for structural steel: Non-shrink, non-metallic, pre-mixed, factory-packaged grout conforming to ASTM C1107/C1107M-07.

## 2.03 DESIGN CRITERIA

- A. Unless noted otherwise, steel to steel framing shall be designed for shear only, and shall use standard framed beam connections (double clip angles) meeting the requirements of the AISC Manual of Steel Construction. Connections shall be symmetrical about the beam web.
- B. Single plate shear tab connections meeting the requirements of the AISC Manual of Steel Construction may be substituted for standard framed beam connections (double clip angles) if and only if one of the following conditions are met:

1. Connection is detailed as a single plate shear tab
  2. Connections of beams to one side of a girder are matched by similar connections at similar spacing on the opposite side of the same girder.
- C. Connections shall be designed for reactions shown on drawings. Where no reactions are shown, the connections shall be designed by the fabricator's engineer to support 50 percent (for non-composite beams) or 50 percent times a multiplier (for composite beams) of the total uniform load capacity noted in the AISC Manual of Steel Construction for the given member size, span and grade of steel. Multipliers for composite beams are noted on drawings.
- D. Provide a minimum of two 3/4 inch diameter A325 or A490 bolts per connection.
- E. Connection shall be designed as field bolted unless specifically noted otherwise

## 2.04 FABRICATION

### A. GENERAL

1. Fabricate and assemble in shop to the greatest extent possible. Fabricate in accordance with AISC "Code of Standard Practice for Steel Buildings and Bridges"
2. Fabricate items of structural steel according to approved Shop Drawings. Fabrication from Shop Drawings not approved by the Engineer is at the sole risk of the Fabricator.
3. Camber structural steel where noted. Where no camber is noted, beams shall be fabricated so that natural camber is upward in the erected condition.
4. Perform thermal cutting by machine. For cut edges to be welded, comply with AWS D1.1.
5. Combinations of bolts and welds on the same faying surface in the same connection are not permitted unless otherwise detailed.
6. Accurately finish ends of columns and other members transmitting bearing loads.
7. Required straightening of built-up sections shall be performed to minimize residual stresses.
8. Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members as shown on Structural Drawings or approved by Engineer.
9. Complete structural-steel assemblies before starting shop painting operations.
10. Properly mark materials for field assembly.

### B. WELDS

1. Comply with AWS D1.1 for welding procedures, tolerances, appearance and quality of welds, and for methods used in correcting welding work. Use only welders qualified in accordance with AWS D1.1 and possessing current valid welding certifications for the welds being performed.
2. Minimum fillet weld size shall be as specified by AISC for the thickness of the thinner part joined, but in no case less than 3/16 inch.
3. Perform welding to minimize residual stress and external distortion of welded assembly.
4. Provide backing bars and run-off tabs for full penetration welds. Remove backing bars and run-off tabs after completion of welds.

C. BOLTS

1. Provide drilled or punched holes perpendicular to surface for shop and field bolted connections. Oversize or slotted holes shall not be used for connections unless specifically noted.
2. Shop bolted connections shall use high strength bolts and nuts, and shall be installed "snug tight" as defined by RCSC unless noted otherwise. Washers are required where the outer face of the joint slopes greater than 1:20 with respect to the axis of the bolt, or where a slotted hole occurs in an outer ply.
3. Twist-off tension-control bolt assemblies shall be used for connections designated as pre-tensioned or slip-critical, and may be used for other connections. Unless connection is designated as pre-tensioned (PT) or slip-critical (SC), bolts shall be tightened only to "snug tight" condition as defined by RCSC, and spline shall not be removed from bolt assembly.

D. SHEAR CONNECTORS, HEADED/DEFORMED BAR CONCRETE ANCHORS AND THREADED BASE STUDS

1. Remove paint on surfaces to receive connectors/anchors/studs.
2. Install in accordance with manufacturers' recommendations using automatically timed welding equipment as furnished by TRW, Nelson Division. Hand operated shielded metal arc welding is not permitted.
3. Adjust equipment on trial installations until sound anchorages are obtained. A minimum of two successive trial installations for each type of anchor used shall be successfully welded and tested by visual inspection and by bending approximately 30 degrees before beginning production. Record settings used during successful installation, including date and time of test and name of installer. Trials shall be conducted by each installer. Trial installations shall not be used for production.
4. If there is a change in the power source, gun lift and plunge settings, welding lead length, current settings or time settings in excess of 5%, equipment shall be re-adjusted by conducting new trials.
5. Ferrules shall be removed after installation to facilitate inspection.

2.05 FINISHES

A. GALVANIZING

1. Steel designated to be galvanized, except for structural bolts, washers and nuts, shall be hot dip galvanized after fabrication in accordance with ASTM A123/A123M-02.
2. Galvanizing for structural bolts, washers and nuts shall conform to the following:
  - a. Bolts conforming to ASTM A325 and associated washers and nuts shall be hot dip galvanized in accordance with ASTM A153/A153M-05. Nuts shall be lubricated after galvanizing. Bolts, washers and nuts shall be considered a fastener assembly, shall be provided by a single supplier, and shall be shipped together in the same shipping container.
  - b. Bolt assemblies conforming to ASTM F1852-05 shall be mechanically galvanized in accordance with ASTM B695-04. Nuts shall be lubricated after galvanizing.
  - c. Bolts conforming to ASTM A490 and associated washers and nuts, and bolt assemblies conforming to ASTM F2280-06 shall not be galvanized.

3. Galvanize components indicated and components exposed to the exterior whether indicated or not. For the purposes of this paragraph, components providing direct support for exterior cladding shall be considered exposed to the exterior.
4. Fill vent holes and grind smooth after galvanizing. Apply galvanizing repair paint.

B. PAINTING

1. After inspection and before shipping, clean steel work to be painted to remove oil, grease and similar contaminants complying with SSPC-SP 1. Further cleaning shall be in accordance with paint manufacturer's requirements, but in no case less than the following:
  - a. For interior members not exposed to view use SSPC-SP 2 or SSPC-SP 3
  - b. For interior members exposed to view use SSPC-S10
  - c. For exterior members exposed to atmosphere, and for faying surfaces of members at connections designated as slip-critical (SC) use SSPC-SP 6 or SSPC-SP 10
2. Shop paint structural steel except:
  - a. Embedded portion of member further than 2 inches from surface of concrete or mortar in which it is embedded.
  - b. Surfaces of members to receive field applied shear studs, dowel bar anchors, or similar welded attachments.
  - c. Contact surfaces which are to be field welded.
  - d. Faying surfaces of members where a slip-critical connection is required. Protect faying surfaces from overspray during painting operations.
  - e. Members which are scheduled to receive sprayed-on fireproofing.
  - f. Members designated to be galvanized.
3. Apply structural steel primer paint in accordance with manufacturer's instructions, but in no case at a rate less than that which provides a uniform dry film thickness of 2.0 mils to 3.5 mils for interior unexposed steel or 2.5 mils to 3.5 mils for interior exposed and exterior steel.
4. Use painting methods which result in coverage of joints, corners, edges and exposed surfaces. Stripe paint corners, crevices, bolts, welds, and sharp edges. Stripe paint shall set to touch before applying primer coat.

2.06 SOURCE QUALITY CONTROL

A. GENERAL

1. Owner will engage an independent testing and inspection agency to perform shop tests and inspections and prepare test reports.
2. Cooperate with inspection and testing personnel to provide access at point of fabrication.
3. Maintain schedule which permits required visual inspection and non-destructive tests to be performed in groups. Notify testing agency 48 hours prior to performing operations which require inspecting or testing prior to proceeding.
4. Testing agency shall specifically state in a report whether individual test specimens comply with or deviate from requirements of the Contract Documents.
5. Correct deficiencies that inspections and test reports indicate do not comply with the Contract Documents. Bear costs for repair or replacement

of work that has been rejected for non-conformance with the Contract Documents, including the cost of additional testing or retesting.

**B. WELDS**

1. Verify that welders performing work on the project are qualified according to AWS D1.1 for the welds being performed.
2. Visually inspect fillet and partial penetration welds for appropriate size, length and location. Perform appropriate non-destructive testing in accordance with AWS D1.1 on welds which appear defective.
3. Perform one of the following inspection procedures on full penetration welds:
  - a. Magnetic Particle Inspection: ASTM E709. Perform on root pass and on finished weld. Presence of cracks or zones of incomplete fusion or penetration shall be cause for rejection of weld.
  - b. Ultrasonic Inspection: ASTM E164.
  - c. Radiographic Inspection: ASTM E94.

**C. BOLTS**

1. Visually inspect [connection for proper number, size and type of bolt, and for proper installation of hardened and plate washers.
2. Verify presence of visible lubricant on threads of galvanized bolts.
3. For bolted connections, inspection shall be made in accordance with the "Specification for Structural Joints Using ASTM A325 or A490 Bolts", paragraph 9.1. Where twist-off tension-control bolt assemblies are utilized in bolted connections not specifically identified as pre-tensioned (PT) or slip critical (SC), verify that splines have not been removed. If splines have been removed, bolts shall be removed, discarded, and replaced with properly tightened bolts.
4. For bolts identified as pre-tensioned (PT), inspection shall be made in accordance with the "Specification for Structural Joints Using ASTM A325 or A490 Bolts", paragraphs 9.1 and 9.2.3. Additional inspection in accordance with paragraph 9.3 shall be made for bolts identified as slip critical (SC).

**D. SHEAR CONNECTORS, HEADED/DEFORMED BAR CONCRETE ANCHORS AND THREADED BASE STUDS**

1. Verify pre-production test records for installation of shear connectors, concrete anchors and threaded studs.
2. A visual inspection shall be made of shear connectors and headed/deformed bar concrete anchors after installation. If visual inspection of a connector/anchor reveals that a sound weld and a 360 degree flash has not been obtained, the connector/anchor shall also be tested by bending a minimum of 15 degrees off vertical opposite to the missing weld/flash. If the connector/anchor does not become loose it shall be considered acceptable and shall be left in this position. Replace failing connectors/anchors.
3. A visual inspection shall be made of threaded studs after installation. If visual inspection of a threaded stud reveals that a sound weld and a 360 degree flash has not been obtained for the threaded stud, the threaded stud shall be removed and replaced.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify elevations of concrete and masonry bearing surfaces, and locations of anchor rods, bearing plates and other embedments.
- B. Do not proceed with installation until conditions not in conformance with the Contract Documents have been corrected.

### 3.02 PREPARATION

- A. Provide temporary guy lines to achieve and maintain proper alignment of structure as erection proceeds.
- B. Provide temporary shores, braces, and other supports during erection, including connections of sufficient strength to bear imposed loads. Temporary supports may be removed when permanent members and bracing are in place, and final connections have been made.
- C. These requirements do not relieve the Contractor of the responsibility for means, methods, techniques, sequences and procedures of construction, including but not limited to temporary supports, shoring, forming to support imposed loads and other similar items.

### 3.03 ERECTION

#### A. GENERAL

- 1. Set structural steel accurately in locations and to elevations indicated, and in accordance with AISC "Code of Standard Practice for Steel Buildings and Bridges".
- 2. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly.
- 3. Align and adjust members before permanently fastening.
- 4. Do not grout beneath column base plates until columns bearing on the base plates have been set and plumbed.
- 5. Maintain erection tolerances of structural steel within the limits established by the AISC "Code of Standard Practice for Steel Buildings and Bridges".
- 6. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - a. Do not splice members except where shown or specified.
  - b. Do not enlarge unfair holes in members by burning or by use of drift pins. Ream holes that must be enlarged to admit bolts.
  - c. Do not use gas cutting torches in the field to correct fabrication errors in structural framing.

#### B. WELDS

- 1. Comply with AWS D1.1 for welding procedures, tolerances, appearance and quality of welds, and for methods used in correcting welding work. Use only welders qualified in accordance with AWS D1.1 and possessing current valid welding certifications for the welds being performed.
- 2. Utilize field welds only where shown. Field welds shall not be used to replace bolted connections in whole or in part.
- 3. Minimum fillet weld size shall be as specified by AISC for the thickness of the thinner part joined, but in no case less than 3/16 inch.

4. Perform welding to minimize residual stress and external distortion of welded assembly.
5. Provide backing bars and run-off tabs for full penetration field welds. Remove where noted on drawings or required for inspection.

C. BOLTS

1. Fill bolt holes in connection with high strength bolts of the appropriate size and type.
2. Field bolted connections shall use high strength bolts and nuts, and shall be installed snug tight as defined by RCSC unless noted otherwise. Washers are required where the outer face of the joint slopes greater than 1:20 with respect to the axis of the bolt, or where a slotted hole occurs in an outer ply.
3. Twist-off tension-control bolt assemblies shall be used for connections designated as pre-tensioned or slip-critical, and may be used for other connections. Unless connection is designated as pre-tensioned (PT) or slip-critical (SC), bolts shall be tightened only to "snug tight" condition as defined by RCSC, and spline shall not be removed from bolt assembly.

D. SHEAR CONNECTORS, HEADED/DEFORMED BAR CONCRETE ANCHORS AND THREADED BASE STUDS

1. Remove any paint on surfaces to receive connectors/anchors/studs.
2. Install in accordance with manufacturers' recommendations.
3. Adjust equipment on trial installations until sound anchorages are obtained. A minimum of two successive trial installations shall be successfully welded and tested by visual inspection and by bending approximately 30 degrees before beginning production. Record settings used during successful installation, including date and time of test and name of installer. Trials shall be conducted by each installer. Trial installations shall not be used for production.
4. If there is a change in the power source, welding lead length, current settings or time settings in excess of 5%, equipment shall be re-adjusted by installing new trial connectors/anchors/studs.
5. Welding shall not be performed when the steel temperature is below 0° F.

3.04 REPAIR / RESTORATION

- A. Repair damaged galvanized coatings on galvanized items with zinc rich galvanized repair paint in accordance with ASTM A780-01 and manufacturer's written instructions.
- B. Immediately after installation: clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of structural steel.
1. Clean and prepare surfaces by hand-tool cleaning to SSPC-SP 2, or power-tool cleaning to SSPC-SP 3.
  2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
  3. Apply finish paint over dry primer to match adjacent surfaces.

3.05 FIELD QUALITY CONTROL

A. GENERAL

1. Owner will engage an independent testing and inspection agency to perform field tests and inspections and prepare test reports.

2. Cooperate with inspection and testing personnel to provide access to site.
3. Maintain schedule which permits required visual inspection and non-destructive tests to be performed in groups. Notify testing agency 48 hours prior to performing operations which require inspecting or testing prior to proceeding.
4. Testing agency shall specifically state in a report whether individual test specimens comply with or deviate from requirements of the Contract Documents.
5. Correct deficiencies that inspections and test reports indicate do not comply with the Contract Documents. Bear costs for repair or replacement of work that has been rejected for non-conformance with the Contract Documents, including the cost of additional testing or retesting.

**B. WELDS**

1. Verify that welders performing work on the project are qualified according to AWS D1.1 for the welds being performed.
2. Visually inspect fillet and partial penetration welds for appropriate size, length and location. Perform appropriate non-destructive testing in accordance with AWS D1.1 on welds which appear defective.
3. Perform one of the following inspection procedures on full penetration welds:
  - a. Magnetic Particle Inspection: ASTM E709. Perform on root pass and on finished weld. Presence of cracks or zones of incomplete fusion or penetration shall be cause for rejection of weld.
  - b. Ultrasonic Inspection: ASTM E164.
  - c. Radiographic Inspection: ASTM E94.

**C. BOLTS**

1. Visually inspect connection for proper number, size and type of bolt, and for proper installation of hardened and plate washers.
2. Verify presence of visible lubricant on threads of galvanized bolts.
3. For bolted connections, inspection shall be made in accordance with the "Specification for Structural Joints Using ASTM A325 or A490 Bolts", paragraph 9.1. Where twist-off tension-control bolt assemblies are utilized in bolted connections not specifically identified as pre-tensioned (PT) or slip critical (SC), verify that splines have not been removed. If splines have been removed, bolts shall be removed, discarded, and replaced with properly tightened bolts.
4. For bolts identified as pre-tensioned (PT), inspection shall be made in accordance with the "Specification for Structural Joints Using ASTM A325 or A490 Bolts", paragraphs 9.1 & 9.2.3. Additional inspection in accordance with paragraph 9.3 shall be made for bolts identified as slip critical (SC).

**D. SHEAR CONNECTORS, HEADED/DEFORMED BAR CONCRETE ANCHORS AND THREADED BASE STUDS**

1. Verify pre-production test records for installation of shear connectors, concrete anchors and threaded studs.
2. Shear connectors shall be struck with a hammer. Those not producing a "clean" pinging sound indicative of a fully attached shear connector shall be bent 15 degrees off vertical towards the nearest support by striking with a hammer. If shear connector does not become loose and weld is not broken, it shall be considered acceptable, and shall be left in the bent position. Replace failing shear connectors and test as before.



3. A visual inspection shall be made of shear connectors and headed/deformed bar concrete anchors after installation. If visual inspection reveals that a sound weld and a 360 degree flash has not been obtained, the connector/anchor shall also be tested by bending a minimum of 15 degrees off vertical opposite to the missing weld/flash, irrespective of the results of the "ping" test required for shear connectors. If the connector/anchor does not become loose it shall be considered acceptable and shall be left in this position. Replace failing connectors/anchors and inspect as before.
4. A visual inspection shall be made of threaded studs after installation. If visual inspection of a threaded stud reveals that a sound weld and a 360 degree flash has not been obtained for the threaded stud, the threaded stud shall be removed and replaced.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING

### PART 1 - GENERAL

#### 1.1 RELATE DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Modified bituminous sheet waterproofing (Damp proofing)

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
  - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
  - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Source Limitations for Waterproofing System: Obtain waterproofing materials from single source from single manufacturer.

### 2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil- thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Hydrotech, Inc.; VM75.
    - b. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRI 860/861.
    - c. CETCO Building Materials Group, a subsidiary of AMCOL International Corp.; Envirosheet.
    - d. Grace, W. R., & Co. - Conn.; Bituthene 3000/Low Temperature or Bituthene 4000.
    - e. Henry Company; Blueskin WP 100/200.
    - f. Meadows, W. R., Inc.; SealTight Mel-Rol.
    - g. York Manufacturing, Inc.; HydroGard.
  - 2. Physical Properties:
    - a. Tensile Strength, Membrane: 250 psi minimum; ASTM D 412, Die C, modified.
    - b. Puncture Resistance: 40 lbf minimum; ASTM E 154.
    - c. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
    - d. Water Vapor Permeance: 0.05 perms maximum; ASTM E 96/E 96M, Water Method.
  - 3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

### 2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
  - 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

- B. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.

## 2.4 INSULATION

- A. Insulation, General: Comply with Section 072100 "Thermal Insulation."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
  - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
  - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
  - 1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/8 inch for modified bituminous deck-paving waterproofing.

- F. Bridge and cover expansion joints discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.
  - 1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
  - 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
    - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
    - b. At plaza-deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

### 3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
  - 1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.
- E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- F. Seal edges of sheet-waterproofing terminations with mastic.
- G. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.

- H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.
- I. Immediately install protection course with butted joints over waterproofing membrane.

END OF SECTION 07 13 26

This Page Intentionally Left Blank



## SECTION 07 53 23 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Adhered EPDM membrane roofing system.
  - 2. Roof insulation.

#### 1.3 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals' markings.
  - 1. Fire/Windstorm Classification: Class 1A-165.
  - 2. Hail Resistance: SH.
- D. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Base flashings and membrane terminations.
  - 2. Tapered insulation, including slopes.
  - 3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
  - 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturer Certificate: Signed by roofing manufacturer certifying that membrane roofing system complies with requirements specified in "Performance Requirements" Article.
  - 1. Submit evidence of complying with performance requirements.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
- C. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.
- D. Field quality-control reports.

## 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For membrane roofing system to include in maintenance manuals.

## 1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is FM Approvals approved for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Source Limitations: Obtain components including roof insulation for membrane roofing system approved by membrane roofing manufacturer.
- D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

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

#### 1.10 PROJECT CONDITIONS

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

## 1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Special warranty includes membrane roofing, base flashings, roof insulation, roofing accessories, and other components of membrane roofing system.
  - 2. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 EPDM MEMBRANE ROOFING

- A. EPDM: ASTM D 4637, **Type I**, ~~Type II, scrim or fabric internally reinforced~~, uniform, flexible EPDM sheet.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlisle SynTec Incorporated.
    - b. Firestone Building Products.
    - c. GAF Materials Corporation.
    - d. GenFlex Roofing Systems.
    - e. Johns Manville.
  - 2. Thickness: 90 mils, nominal.

### 2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
- B. Sheet Flashing: 60-mil- thick EPDM, partially cured or cured, according to application.
- C. Bonding Adhesive: Manufacturer's standard.
- D. Seaming Material: Single component, butyl splicing adhesive and splice cleaner.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

## 2.3 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by EPDM membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces: 6 inches Minimum depth.
- C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

## 2.4 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
  - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
  - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
  - 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
  - 5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
  - 6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.3 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- D. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- E. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
  - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- F. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
  - 1. Fasten insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
  - 2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

### 3.4 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Adhere membrane roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.

- B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.
- E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeters.
- F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- G. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- H. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

### 3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing agency to perform inspections.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.7 PROTECTING AND CLEANING

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

END OF SECTION 07 53 23



## SECTION 07 71 00 - ROOF SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Copings.
  - 2. Roof-edge flashings.
  - 3. Roof-edge drainage systems.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. SPRI Wind Design Standard: Manufacture and install copings roof-edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressures:
  - 1. Design Pressure: As indicated on Drawings.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

#### 1.4 ACTION SUBMITTALS

- A. Samples for Verification: For copings roof-edge flashings roof-edge drainage systems made from 12-inch lengths of full-size components including fasteners, cover joints, accessories, and attachments.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for copings and roof-edge flashings.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

## PART 2 - PRODUCTS

### 2.1 EXPOSED METALS

- A. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
  - 1. Surface: Smooth, flat finish.
  - 2. Exposed Coil-Coated Finishes: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Three-Coat Fluoropolymer: AAMA 620. System consisting of primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent PVDF resin by weight.
    - b. Concealed Surface: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

### 2.2 CONCEALED METALS

- A. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

### 2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
  - 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color

- of sheet metal.
- 2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
- C. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.4 COPINGS

- A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 12 feet, concealed anchorage; corner units, end cap units, and concealed splice plates with same finish as coping caps.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
    - a. Architectural Products Company.
    - b. Johns Manville.
    - c. Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.
  - 2. Coping-Cap Material: aluminum, 0.063 inch thick.
    - a. Finish: Three-coat fluoropolymer.
    - b. Color: As selected by Architect from manufacturer's full range.
  - 3. Special Fabrications: Radiussed sections .
  - 4. Coping-Cap Attachment Method: Snap-on, fabricated from coping-cap material.

## 2.5 ROOF-EDGE FLASHINGS

- A. Canted Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous formed galvanized-steel sheet cant, 0.028 inch thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.
- B. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous formed- or extruded-aluminum anchor bar with integral drip-edge cleat to engage fascia cover. Provide matching corner units.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Johns Manville.
  - 2. Fascia Cover: Fabricated from the following exposed metal:
    - a. Formed Aluminum: 0.063 inch thick .

3. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
4. Fascia Accessories: Fascia extenders with continuous hold-down cleats .

C. Aluminum Finish: Three-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

## 2.6 ROOF-EDGE DRAINAGE SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Offset face Gutter by Hickman or or comparable product by one of the following:

1. Andreas Renner KG.
2. Architectural Products Company.
3. Berger Building Products, Inc.
4. Hickman Company, W. P.
5. National Sheet Metal Systems, Inc.

B. Gutters: Manufactured in uniform section lengths not exceeding , with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Fabricate from the following exposed metal:
  - a. Formed Aluminum: 0.063 inch thick.
2. Gutter Profile: Style A according to SMACNA's "Architectural Sheet Metal Manual."
3. Corners: Factory mitered and mechanically clinched and sealed watertight.
4. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
5. Special Fabrications: Radiussed sections.
6. Gutter Accessories: Continuous hinged leaf guard of solid metal designed to shed leaves.

C. Downspouts: Open-face rectangular complete with machine-crimped elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.

## 2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.
  - 1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
  - 3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
  - 4. Torch cutting of roof specialties is not permitted.
  - 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
  - 1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise shown on Drawings.
  - 2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

- D. Fastener Sizes: Use fasteners of sizes that will penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Seal joints with sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

### 3.3 COPING INSTALLATION

- A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor copings to meet performance requirements.

### 3.4 ROOF-EDGE FLASHING INSTALLATION

- A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

### 3.5 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

- A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch below gutter discharge.

### 3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.
- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 71 00

## SECTION 07 92 00 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Silicone joint sealants.
  - 2. Urethane joint sealants.

- B. Related Sections:

- 1. Section 042000 "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
  - 2. Section 088000 "Glazing" for glazing sealants.
  - 3. Section 093000 "Tiling" for sealing tile joints.
  - 4. for sealing edge moldings at perimeters with acoustical sealant.

#### 1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
  - 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  - 2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
  - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
  - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

## 1.7 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## 1.8 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.



## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - 1. Architectural Sealants: 250 g/L.
  - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
  - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### 2.2 URETHANE JOINT SEALANTS

- A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Tremco Incorporated; Vulkem 116.
- B. Single-Component, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920. Type S, Grade NS, Class 25, for Use T.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. BASF Building Systems; Sonolastic Ultra.
    - b. Tremco Incorporated; Vulkem 116.
- C. Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.

1. Products: Subject to compliance with requirements, provide the following:

- a. Tremco Incorporated; Vulkem 45.

## 2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.

3. Remove laitance and form-release agents from concrete.
  4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Glazed surfaces of ceramic tile.
    - d. Insert other nonporous joint substrate.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
  2. Do not stretch, twist, puncture, or tear sealant backings.
  3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
  2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

F. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:

1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

G. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

H. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

### 3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage

or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces
  - 1. Joint Locations:
    - a. Isolation and contraction joints in cast-in-place concrete slabs.
  - 2. Urethane Joint Sealant: Single component, pourable, traffic grade.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces
  - 1. Joint Locations:
    - a. Joints between plant-precast architectural concrete units.
    - b. Perimeter joints between materials listed above and frames of doors windows and louvers.
    - c. Control and expansion joints in ceilings and other overhead surfaces.
  - 2. Urethane Joint Sealant: Single component, nonsag, Class 25.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Isolation joints in cast-in-place concrete slabs and joints between the precast panels and floor slab.
  - 2. Urethane Joint Sealant: Single component, nonsag, traffic grade.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 92 00

This Page Intentionally Left Blank

## SECTION 08 11 00 - STEEL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Steel doors
- B. Steel frames
- C. Steel architectural stick systems

#### 1.02 RELATED SECTIONS

- A. Section 08710 - Door Hardware
- B. Section 08800 - Glazing
- C. Section 09900 - Paints and Coatings
- D. Section 13800 - Building Automation and Control: Building monitoring system
- E. Section 16123 - Building Wire and Cable: Power supply to electric hardware devices

#### 1.03 REFERENCES

- A. ASTM - American Society for Testing and Materials
  1. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  2. ASTM A 924 - Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process.
  3. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, High Strength Low-Alloy, High Strength Low Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
  4. ASTM E 90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
  5. ASTM E 413 - Classification for Rating Sound Insulation.
- B. ANSI - American National Standards Institute
  1. ANSI/DHI A115 - Specifications for Hardware Preparations in Standard Steel Doors and Frames.
  2. ANSI/DHI A115.IG - Installation Guide for Doors and Hardware.
  3. ANSI A156.7 - Hinge Template Dimensions.
  4. ANSI A 250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames.
  5. ANSI A250.4 – Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing.
  6. ANSI A 250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames.
  7. ANSI A 250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
  8. ANSI/SDI 250.11 - Recommended Erection Instructions for Steel Frames

C. SDI - Steel Door Institute

1. SDI 105 - Recommended Erection Instructions for Steel frames.
2. SDI 111 - Recommended Details and Guidelines for Standard Steel Doors and Frames and Accessories.
3. SDI 112 - Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames.
4. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.
5. SDI 118 - Basic Fire Door Requirements.
6. SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
7. SDI 124 - Maintenance of Standard Steel Doors and Frames.

D. NAAMM/HMMA - Hollow Metal Manufacturers Association

1. HMMA 840 - Guide Specification for Installation and Storage of Hollow Metal Doors and Frames
2. HMMA 820 TN01- Grouting Hollow Metal Frames
3. HMMA 820 TN03 – Guidelines for Glazing of Hollow Metal Transom, Sidelight and Windows

E. Building Code references

1. UL 1784 - Air Leakage Tests of Door Assemblies
2. UL - Building Materials Directory; Underwriters Laboratories Inc
3. WH - Certification Listings; Warnock Hersey International Inc.
4. Federal Emergency Management Agency (FEMA) 361 Guidelines

1.04 REQUIREMENTS OF REGULATORY AGENCIES:

- A. Doors and frames: conform to applicable codes for fire ratings. It is the intent of this specification that door hardware and its application comply or exceed the standards for labeled openings. In case of conflicts in required fire protection ratings, provide fire ratings as required by NFPA and UL.

1. Fire door assemblies in exit enclosures and exit passageways: maximum transmitted temperature end point of not more than 250°F (121°C) above ambient at the end of 30 minutes of the standard fire test exposure.

1.05 SUBMITTALS

- A. Submit UL approved to FEMA 361 and FEMA 320 Doors, Frames and the associated hardware as an assembly at the same time.
- B. Submit for review six (6) complete copies of the hollow metal shop drawings covering complete identification of items required for the project. Include manufacturer's names and identification of product. Included six (6) complete copies of catalog cuts and/or technical data sheets and other pertinent data as required to indicate compliance with these specifications.
1. Shop Drawings: submit complete and detailed with respect to quantities, dimensions, specified performance, and design criteria, materials and similar data to enable the Architect to review the information as required.
- C. Indicate frames configuration, anchor types and spacing, location of cutouts for hardware, reinforcement, to ensure doors and frames are properly prepared and coordinated to receive hardware.



- D. Indicate door elevations, internal reinforcement, closure method, and cutouts for glass lights and louvers.
- E. Submit manufacturer's installation instructions, including a current copy of ANSI A250.11 as part of the shop drawing submittal.
- F. Shop drawings, product data, and samples: stamp with Contractor's stamp verifying they have been coordinated and reviewed for completeness and compliance with the contract documents.
- G. Shop drawings submitted without the above requirements will be considered incomplete, will NOT be reviewed, and will be returned directly to the Contractor.
- H. Follow the same procedures for re-submittal as the initial submittal with the appropriate dates revised.
- I. Provide evidence of manufacturer's membership in the Steel Door Institute.

#### 1.06 QUALITY ASSURANCE

- A. Select a qualified hollow metal distributor who is a direct account of the manufacturer of the products furnished. In addition, that distributor must have in their regular employment an Architectural Hardware Consultant (AHC), a Certified Door Consultant (CDC) or an Architectural Openings Consultant (AOC), who will be available to consult with the Architect and Contractor regarding matters affecting the door and frame opening.
- B. Conform to requirements of the above reference standards. Submit test reports upon request by the Owner or Architect.
- C. Underwriters' Laboratories and Intertek Testing Services / Warnock Hersey, labeled fire doors and frames:
  - 1. Label fire doors and frames listed in accordance with Underwriters Laboratories standard UL10C, and Positive Pressure Fire Tests of Door Assemblies.
  - 2. Construct and install doors and frames to comply with applicable issue of ANSI/NFPA 80.
  - 3. Manufacture Underwriters' Laboratories labeled doors and frames under the UL factory inspection program and in strict compliance to UL procedures, and provide the degree of fire protection, heat transmission and panic loading capability indicated by the opening class.
  - 4. Manufacture Intertek Testing Services / Warnock Hersey labeled doors and frames under the ITS/WH factory inspection program and in strict compliance to ITS/WH procedures, and provide the degree of fire protection capability indicated by the opening class.
  - 5. Affixed physical label or approved marking to fire doors and/or fire door frames, at an authorized facility as evidence of compliance with procedures of the labeling agency. Labels to be metal, paper or plastic. Stamped or die cast labels are not permitted. Labels are not to be

removed, defaced or made illegible while the door is in service as covered in NFPA Pamphlet 80.

6. Conform to applicable codes for fire ratings. It is the intent of this specification that hardware and its application comply or exceed the standards for labeled openings. In case of conflict between types required for fire protection, furnish type required by NFPA and UL.

D. Severe Storm Products:

1. Tornado Doors: Door Systems for Federal Emergency Management Agency (FEMA) community shelters and other areas of refuge meeting the design wind pressures and missile impact loads as detailed in the National Performance Criteria for Tornado Shelters as published by FEMA.

E. Manufacturer Qualifications: Member of the Steel Door Institute.

F. Installer: Minimum five years documented experience installing products specified in this Section.

## 1.07 DELIVERY, STORAGE, AND HANDLING

A. Storage of Doors

1. Store doors vertically in a dry area, under proper cover. Place the units on at least 4" high wood sills on floors in a manner that will prevent rust and damage. Avoid storage in non-vented plastic or canvas shelters, which create a humidity chamber and promote rusting. If the door becomes wet, or moisture appears, remove protective wrapping immediately. Provide a 4" space between the doors to permit air circulation. Proper storage is required to meet the requirements of ANSI/SDI A250.11 and HMMA 840.

B. Storage of Frames

1. Store frames in an upright position with heads uppermost under cover on 4" wood sills on floors in a manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters, which create a humidity chamber and promote rusting. Store assembled frames in a vertical position, five units maximum in a stack. Provide a 2" space between frames to permit air circulation.
2. Provide proper storage for doors and frames, to maintain the quality and integrity of the factory applied paint, and maintain the requirements of ANSI/SDI A250.10 and HMMA 840.
3. Sand, touch up and clean prime painted surfaces prior to finish painting in accordance with the manufacturer's instructions.

## 1.08 COORDINATION

- A. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal cutouts and reinforcement for door hardware, electric devices and recessed items.
- B. Coordinate work with frame opening construction, door and hardware installation.
- C. Sequence installation to accommodate required door hardware.
- D. Verify field dimensions for factory assembled frames prior to fabrication.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Acceptable manufacturers for doors and frames specified are listed below. Only the products of the listed manufacturers will be accepted. No alternates will be accepted.
  - 1. Steelcraft, Cincinnati, Ohio
  - 2. Curries, Mason City, Iowa
- B. Provide steel doors and frames from a single manufacturer.

### 2.02 DOORS:

- A. Construct exterior/interior doors to these designs and gages:
  - 1. Exterior Doors: Zinc-Iron Alloy-Coated galvanized steel, ASTM A 653, Class A60, or 14 gage [0.067" (1.7mm)] Zinc-Iron Alloy-Coated galvanized steel, with closed tops.
    - a. Include galvanized components and internal reinforcements with galvanized doors.
    - b. Close tops of exterior swing-out doors to eliminate moisture penetration. Galvanized steel top caps are permitted.
  - 2. Interior Doors: Cold-rolled steel, A 1008, 18 gage [0.042" (1mm)] cold rolled steel.
    - a. Include galvanized components and internal reinforcements with galvanized doors.
  - 3. Factory prime painted doors indicated on door schedule as HM.
  - 4. Hardware Reinforcements:

- a. Hinge reinforcements for full mortise hinges: minimum 7 gage [0.180" (4.7mm)].
  - b. Lock reinforcements: minimum 16 gage [0.053" (1.3mm)].
  - c. Closer reinforcements: minimum 14 gage [0.067" (1.7mm)], 20" long.
  - d. Galvannealed doors: include galvannealed hardware reinforcements.
  - e. Projection welded hinge and lock reinforcements to the edge of the door.
  - f. Provided adequate reinforcements for other hardware as required.
5. Glass moldings and stops (both labeled and non-labeled doors):
- a. Fabricate glass trim from 24 gage [.6mm] steel conforming to:
    - 1 Interior openings ASTM designation A 366 cold rolled steel
    - 2 Exterior openings ASTM designation A 924 Zinc-Iron Alloy-Coated galvannealed steel with a zinc coating of 0.06 ounces per square foot (A60) for exterior openings.
  - b. Install trim into the door as a four sided welded assembly with mitered, reinforced and welded corners.
  - c. Trim: identical on both sides of the door.
  - d. Exposed fasteners are not permitted. Labeled and non-labeled doors: use the same trim.
  - e. Acceptable mounting methods:
    - 1 Fit into a formed area of the door face, not extending beyond the door face, and interlocking into the recessed area
    - 2 Cap the cutout not extend more than 1/16" [1.6mm] from the door face.

**B. Full Flush Type Doors Construction**

- 1. ANSI-A250.4 criteria and tested to 5,000,000 operating cycles.
- 2. Approved door core constructions:

- a. **Polystyrene:** Reinforced, stiffened, sound deadened and insulated with a rigid polystyrene core bonded to the inside faces of both panels with contact adhesive. Fill voids around the perimeter of the door with honeycomb. Acceptable products:
        - 1 Steelcraft: L with polystyrene option
        - 2 Curries: 707D
  - 3. Vertical edge seams: Provide doors with continuous vertical mechanical inter-locking joints at lock and hinge edges with visible edge seams, or a one piece full height 14 gage channel. Apply a continuous bead of structural epoxy in the internal vertical connection.:
    - a. Welded Vertical Edges (W): Continuous vertical mechanical interlocking joint; edge seams welded, epoxy filled, and ground smooth.
        - 1 Steelcraft LW edge option
        - 2 Curries: T edge option
  - 4. Bevel hinge and lock door edges 1/8 inch (3 mm) in 2 inches (50 mm). Square edges on hinge and/or lock stiles are not acceptable.
  - 5. Reinforce top and bottom of doors with galvanized 14 gage, welded to both panels.
- C. Tornado Door Systems: comply with Federal Emergency Management Agency (FEMA) 361 Guidelines and provides the highest level of security and safety for tornado shelters and severe storm areas of refuge.
- 1. Acceptable Product:
    - a. Steelcraft Paladin Tornado Door Systems.
      - 1 Steelcraft: P
      - 2 Curries: Stormpro
  - 2. Face sheets: 14 gage [0.067" (1.7mm)] hot-dipped galvanized steel having an A60 zinc-iron alloy coating conforming to ASTM designations A653 and A924.
  - 3. Hinge and lock edges: include continuous vertical mechanical joints with edge seams welded, filled and ground smooth.
  - 4. Bevel hinge and lock door edges 1/8 inch (3 mm) in 2 inches (50 mm). Square edges on hinge and/or lock stiles are not acceptable
  - 5. Galvanized 14 gage [0.067" (1.7mm)] top and bottom steel reinforcement channels projection welded to both face sheets on 4 inches (102 mm) centers.
  - 6. Hinge reinforcements: minimum 7 gage [0.167" (4.4mm)] galvanized steel, projection welded to the edge of the door.

7. Reinforce door faces with 18 gage [0.042" (1.0mm)] vertical stiffeners manufactured from steel conforming to ASTM A653 and A924 and welded to each face sheet.
8. Reinforce lock stiles with full-height 12 gage [0.093" (2.5mm)] channels.
9. Fire Rated Doors: Provide door units bearing Labels for fire ratings required in locations indicated.

D. Electrical Requirements:

1. General: Coordinate electrical requirements for doors and frames. Make provisions for installation of electrical items arranged so that wiring can be readily removed and replaced.

2.03 DOOR FRAMES:

A. Construct exterior and metal door frames to these profiles, designs and gages;

1. Exterior Frames: Zinc-Iron Alloy-Coated galvanized steel, ASTM A 653, Class A60, 14 gage [0.067" (1.7mm)] Zinc-Iron Alloy-Coated galvanized steel.
2. Interior Frames in Masonry: Zinc-Iron Alloy-Coated galvanized steel, ASTM A 653, Class A60, 16 gage [0.053" (1.3mm)] galvanized steel.
3. Interior Frames in stud wall construction: 16 gage [0.053" (1.3mm)] cold rolled frames.
4. Include galvanized components and internal reinforcements with galvanized frames.

B. Flush Frames: knocked down for field assembly or set-up and welded with temporary shipping bars. Factory die-mitered corner connections reinforced with four integral tabs to secure and interlock at jambs to head. Unless otherwise indicated, frame will have 2" faces and 5/8" stops. Frame depths per the architectural door schedule.

1. Provide frames with a minimum of six wall anchors and two adjustable base anchors of manufacturer's standard design. Acceptable products:
  - a. Steelcraft: F
  - b. Curries: M
2. For Paladin Series tornado resistant assemblies provide:
  - a. Steelcraft: FP14
3. Provide welded 3 sided frames as follows:
  - a. Full profile welded:

- 1 Weld miter joints between head and jamb faces completely along their length either internally or externally.
- 2 Internally weld perimeter profile joints full length of soffit and rabbets with hairline seams on external meeting surfaces. Grind and finish face joints smooth.

4. Base anchor options:

- a. Weld-in base anchor attaching plate in each jamb for field installation of loose base anchors to allow proper anchoring at base of frame. Acceptable products:
  - 1 Steelcraft: DW
  - 2 Curries: C with P0087

C. Prepare frames to receive inserted type door silencers (3) per strike jamb on single doors, and (2) per head for pair of doors. Stick-on silencers are not permitted.

D. Frame Hardware Reinforcements

:

1. Mortise hinge reinforcement: minimum 7 gage [0.180" (4.7mm)].
  - a. Provide high frequency hinge reinforcement for top hinge on all exterior, cross corridor, and stairwell frames, in accordance with SDI 111-H, Example "A" Application, where full mortise hinges are specified.
2. Strike reinforcements: minimum 16 gage [0.053" (1.3mm)] and prepared for an ANSI-A115.1-2 strike.
3. Closer reinforcement: minimum 14 gage [0.067" (1.7mm)] steel.
4. Projection weld hinge and strike reinforcements to the door frame.
5. Provide metal plaster guards for all mortised cutouts.
6. Provide adequate reinforcements for other hardware as required.
7. Include galvanized hardware reinforcements in all galvanized frames.

E. Electrical Requirements:

1. General: Coordination all electrical requirements for doors and frames. Make provisions for installation of electrical items arranged so that wiring can be readily removed and replaced.
  - a. Provide cutouts and reinforcements required for metal door frame to accept electric components.

- b. Frame with Electrical Hinges: Weld UL listed grout guard cover box welded over center hinge reinforcing. Top or bottom hinge locations are not permitted. Contractor to reference 3.01.E, for continuous hinges.
- a. Provide cutouts and reinforcements required to accept security system components.
- b. Refer to 08710 for electrified hardware items.

## 2.05 FABRICATION:

### A. Full Profile Welded Frames:

- 1. Continuous welded miter joints between head and jamb faces completely along their length either internally or externally. Internally weld perimeter profile joints full length of soffit and rabbets with hairline seams on external meeting surfaces. Grind and finish face joints smooth.
- 2. Externally weld, grind, prime paint, and finish smooth face joints at meeting mullions or between mullions and other frame members per a current copy of ANSI/SDI A250.8.
- 3. Provide two temporary steel spreaders (welded to the jambs at each rabbet of door openings) on welded frames during shipment. Remove temporary steel spreaders prior to installation of the frame.

## 2.06 FINISH:

- A. Doors, frames and frame components are required to be cleaned, phosphatized, and finished with one coat of baked-on rust inhibiting prime paint in accordance with the ANSI/SDI A250.10 "Test Procedures and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

## PART 3 - EXECUTION:

### 3.01 INSTALLATION:

- A. Install doors and frames in accordance with Steel Door Institute's recommended erection instructions for steel frames ANSI A250.11.
- B. Install label doors and frames in accordance with NFPA-80.
- C. Remove temporary steel spreaders prior to installation of frames.
- D. Set frames accurately in position; plumb, align and brace until permanent anchors are set. After wall construction is complete, remove temporary wood spreaders.
  - 1. Field splice only at approved locations indicated on the shop drawings. Weld, grind, and finish as required to conceal evidence of splicing on exposed faces.



- E. Provide full height 3/8" to 1-1/2" thick strip of polystyrene foam blocking at non-labeled frames requiring grouting where continuous hinges are specified. Apply the strip to the back of the frame, where the hinge is to be installed, to facilitate field drilling or tapping.
- F. Where grouting is required in masonry, provide and install temporary bottom and intermediate wood spreaders to maintain proper width and avoid bowing or deforming of frame members. Refer to ANSI A250.11-2001, Standard.

- 2. Hollow Metal Frames to receive grouting: comply with a current copy of ANSI/SDI Standard A250.8, paragraph 4.2.2, whereby grout will be mixed to provide a 4" maximum slump consistency and hand troweled into place. Do not use grout mixed to a thinner, pumpable consistency; this practice is not recommended and not permissible. Refer to HMMA 820 TN01 Grouting Hollow Metal Frames.

- G. Provide a vertical wood brace during grouting of frame at openings over 4'0" wide, to prevent sagging of frame header.
- H. Glaze and seal exterior transom, sidelight and window frames in accordance with HMMA-820 TN03.
- I. Apply hardware in accordance with hardware manufacturers' instructions and Section 08710 FINISH HARDWARE of these Specifications. Install hardware with only factory-provided fasteners. Adjust door installation to provide uniform clearance at head and jambs, to achieve maximum operational effectiveness and appearance.

### 3.02 ADJUSTING:

- A. Final Adjustments: Adjust operating doors and hardware items just prior to final inspection and acceptance by the Owner and Architect. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames that are damaged, bowed or otherwise unacceptable.
- B. Prime Coat Touch-Up: Immediately after erection, sand smooth rusted or damaged areas of prime coat, and apply touch-up of compatible air-drying primer.

### 3.03 PROTECTION

- A. Provide protective measures required throughout the construction period to ensure that door and frame units will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION 08 11 00

This Page Intentionally Left Blank

## SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Interior aluminum doors
2. Storefront framing for punched openings. These openings will also receive HM Doors and Frames.

RELATED SECTIONS: 08 11 00 HM Doors and Frames.

#### 1.3 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
  1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
  2. Dimensional tolerances of building frame and other adjacent construction.
  3. Failure includes the following:
    - a. Deflection exceeding specified limits.
    - b. Thermal stresses transferring to building structure.
    - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
    - d. Noise or vibration created by wind and by thermal and structural movements.
    - e. Loosening or weakening of fasteners, attachments, and other components.
    - f. Sealant failure.

- g. Failure of operating units.
- B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:
  - 1. Wind Loads:
    - a. Basic Wind Speed: 90 mph
    - b. Exposure Category: A
  - 2. Seismic Loads: As indicated on Drawings.
- D. Deflection of Framing Members:
  - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed  $L/175$  of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to  $3/4$  inch, whichever is less.
- E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
  - 1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
  - 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
  - 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..
- G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- H. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- I. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
  2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
    - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
    - b. Low Exterior Ambient-Air Temperature: 0 deg F.
  3. Interior Ambient-Air Temperature: 75 deg F.
- J. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
  1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
  1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. CMI Architectural Commercial Architectural Products, Inc.
  - 2. Kawneer
  - 3. EFCO Corporation.
  - 4. Pittco Architectural Metals, Inc.
  - 5. TRACO.
  - 6. MANKO Window Systems Inc.

### 2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  - 1. Sheet and Plate: ASTM B 209.
  - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
  - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
  - 4. Structural Profiles: ASTM B 308/B 308M.

### 2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  - 1. Construction: Thermally broken for the exterior punch openings and standard for the vestibule framing including door frames.
  - 2. Glazing System: Retained mechanically with gaskets on four sides.
  - 3. Glazing Plane: As indicated.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Concealed Flashing: Dead-soft, 0.018-inch- thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.
- F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.188-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
  2. Door Design: Wide stile; 5-inch nominal width.
  3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
- B. Entrance Door Hardware: As specified in Section 087100 "Door Hardware."

## 2.5 GLAZING SYSTEMS

- A. Glazing: As specified in Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

## 2.6 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 079200 "Joint Sealants."

## 2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
  - 4. Physical and thermal isolation of glazing from framing members.
  - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 6. Provisions for field replacement of glazing from .
  - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- D. Storefront Framing: Fabricate components for assembly using shear-block system.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
  - 1. At exterior doors, provide compression weather stripping at fixed stops.
  - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.8 ALUMINUM FINISHES

- G. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 INSTALLATION

#### A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

#### B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

#### C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

#### D. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

#### E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

#### F. Install glazing as specified in Section 088000 "Glazing."

#### G. Install perimeter joint sealants as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

#### H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

### 3.3 ERECTION TOLERANCES

#### A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:
  - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
  - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
  - 1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft., of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..
  - 2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing under "Performance Requirements" Article, but not less than 4.18 lbf/sq. ft., and shall not evidence water penetration.
  - 3. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 75 feet by 1 story of aluminum-framed systems designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
- B. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

END OF SECTION 08 41 13

## SECTION 08 71 00 – DOOR HARDWARE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes:

- 1. Mechanical and electrified door hardware for:
  - a. Swinging doors.
- 2. Electronic access control system components, including:
  - a. Electronic exit device trim.

- B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

- 1. Windows
- 2. Cabinets (casework), including locks in cabinets
- 3. Signage
- 4. Toilet accessories
- 5. Overhead doors

- C. Related Sections:

- 1. Division 01 Section “Alternates” for alternates affecting this section.
- 2. Division 07 Section “Joint Sealants” for sealant requirements applicable to threshold installation specified in this section.
- 3. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.
- 4. Division 13 Section “Radiation Protection” for requirements for lead-lining for door hardware at openings indicated to receive radiation protection.
- 5. Division 26 sections for connections to electrical power system and for low-voltage wiring.
- 6. Division 28 sections for coordination with other components of electronic access control system.

### 1.3 REFERENCES

#### A. Fire/Life Safety

1. NFPA - National Fire Protection Association
  - a. NFPA 70 – National Electric Code
  - b. NFPA 80 - Standard for Fire Doors and Fire Windows
  - c. NFPA 101 - Life Safety Code
  - d. NFPA 105 - Smoke and Draft Control Door Assemblies
2. State Fire Safety Code.

#### B. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

#### C. Accessibility

1. ADA - Americans with Disabilities Act.
2. ANSI A117.1 - Accessible and Usable Buildings and Facilities.

#### D. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Key Systems and Nomenclature

#### E. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI A156.31 - Standards for Hardware and Specialties

### 1.4 SUBMITTALS

#### A. General:

1. **Submit UL approved to FEMA 361 and FEMA 320 Doors, Frames and the associated hardware as an assembly at the same time.**
2. Submit in accordance with Conditions of Contract and Division 01 requirements.
3. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
4. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.

B. Action Submittals:

1. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
  - a. Wiring Diagrams: For power, signal, and control wiring and including:
    - 1) Details of interface of electrified door hardware and building safety and security systems.
    - 2) Schematic diagram of systems that interface with electrified door hardware.
    - 3) Point-to-point wiring.
    - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
  - a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
  - a. Door Index; include door number, heading number, and Architects hardware set number.
  - b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
  - c. Type, style, function, size, and finish of each hardware item.
  - d. Name and manufacturer of each item.
  - e. Fastenings and other pertinent information.
  - f. Location of each hardware set cross-referenced to indications on Drawings.
  - g. Explanation of all abbreviations, symbols, and codes contained in schedule.
  - h. Mounting locations for hardware.
  - i. Door and frame sizes and materials.
  - j. Name and phone number for local manufacturer's representative for each product.
  - k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
    - 1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

5. Key Schedule:

- a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
  - b. Use ANSI A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
  - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
  - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
  - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
    - 1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
  - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product Certificates for electrified door hardware, signed by manufacturer:
  - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
3. Certificates of Compliance:
  - a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
  - b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
  - c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
5. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data : Provide in accordance with Division 01 and include:
  - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
  - b. Catalog pages for each product.

- c. Name, address, and phone number of local representative for each manufacturer.
- d. Parts list for each product.
- e. Final approved hardware schedule, edited to reflect conditions as-installed.
- f. Final keying schedule
- g. Copies of floor plans with keying nomenclature
- h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
- i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

## 1.5 QUALITY ASSURANCE

- A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
  - 1. Where specific manufacturer's product is named and accompanied by "No Substitute," including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
    - a. Where no additional products or manufacturers are listed in product category, requirements for "No Substitute" govern product selection.
  - 2. Where products indicate "acceptable substitute" or "acceptable manufacturer", provide product from specified manufacturers, subject to compliance with specified requirements and "Single Source Responsibility" requirements stated herein.
- B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
  - 1. Warehousing Facilities: In Project's vicinity.
  - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
  - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
  - 4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
    - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.

- D. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
  2. Can provide installation and technical data to Architect and other related subcontractors.
  3. Can inspect and verify components are in working order upon completion of installation.
  4. Capable of producing wiring diagrams.
  5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
- E. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
  2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- F. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- G. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets 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 tested pressure differential of 0.3-inch wg (75 Pa) of water.
- H. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- I. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.
- J. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.
1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
  2. Maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
    - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
    - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
  3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.



4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.
- K. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.
1. Attendees: Owner, Contractor, Architect, Installer, and Supplier's Architectural Hardware Consultant.
  2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
    - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
    - b. Preliminary key system schematic diagram.
    - c. Requirements for key control system.
    - d. Requirements for access control.
    - e. Address for delivery of keys.
- L. Pre-installation Conference: Conduct conference at Project site.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  2. Inspect and discuss preparatory work performed by other trades.
  3. Inspect and discuss electrical roughing-in for electrified door hardware.
  4. Review sequence of operation for each type of electrified door hardware.
  5. Review required testing, inspecting, and certifying procedures.
- M. Coordination Conferences:
1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
    - a. Attendees: Door hardware supplier, door hardware installer, Contractor.
    - b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.
  2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
    - a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, Architect and Contractor.
    - b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.

- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
  - 1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
  - 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
  - 2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
  - 1. Promptly replace products damaged during shipping.
  - 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
  - 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- F. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

## 1.7 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

## 1.8 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: Years from date of Substantial Completion, for durations indicated.

- a. Closers:
    - 1) Mechanical: 10 years.
    - 2) Electrified: 2 years.
  - b. Exit Devices:
    - 1) Mechanical: 3 years.
    - 2) Electrified: 1 year.
  - c. Locksets:
    - 1) Mechanical: 3 years.
    - 2) Electrified: 1 year.
  - d. Continuous Hinges: 10 years.
  - e. Key Blanks: Lifetime
2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

## 1.9 MAINTENANCE

### A. Maintenance Tools:

1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Approval of manufacturers other than those listed shall be in accordance with QUALITY ASSURANCE article, herein.
- B. Approval of products from manufacturers indicated as “Acceptable Manufacturer” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

| Item                       | Scheduled Manufacturer     | Acceptable Manufacturer |
|----------------------------|----------------------------|-------------------------|
| Hinges                     | Ives (IVE)                 | McKinney                |
| Continuous Hinges          | Ives (IVE)                 | McKinney                |
| Electric Door Cord         | Schlage – Electronic (SCE) | Sargent                 |
| Flush Bolts & Coordinators | Ives (IVE)                 | McKinney                |
| Locksets & Deadlocks       | Schlage (SCH)              | Sargent                 |
| Three Point Lock           | Schlage (SCH)              | Sargent                 |
| Wind Storm Exit Devices    | Von Duprin (VON)           | Sargent                 |
| Cylinders & Keying         | Schlage (SCH)              | Sargent                 |
| Door Closers               | LCN (LCN)                  | Sargent                 |

|                           |                      |             |
|---------------------------|----------------------|-------------|
| Door Trim                 | Ives (IVE)           | McKinney    |
| Protection Plates         | Ives (IVE)           | McKinney    |
| Overhead Stops            | Glynn-Johnson (GLY)  | Sargent     |
| Stops & Holders           | Ives (IVE)           | McKinney    |
| Thresholds & Weatherstrip | National Guard (NGP) | Pemko, Zero |
| Silencers                 | Ives (IVE)           | McKinney    |

- C. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

## 2.2 MATERIALS

### A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
  2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
  3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
  4. Install hardware with fasteners provided by hardware manufacturer.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

## 2.3 HINGES

### A. Provide five-knuckle, ball bearing hinges.

1. Manufacturers and Products:
  - a. Scheduled Manufacturer and Product: Ives 5BB series.
  - b. Acceptable Manufacturers and Products: McKinney TB/T4B series.

### B. Requirements:

1. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:

- a. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
2. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
  - a. Interior: Heavy weight, steel, 5 inches (127 mm) high
3. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
4. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
  - a. Steel Hinges: Steel pins
  - b. Non-Ferrous Hinges: Stainless steel pins
  - c. Out-Swinging Exterior Doors: Non-removable pins
  - d. Out-Swinging Interior Lockable Doors: Non-removable pins
  - e. Interior Non-lockable Doors: Non-rising pins
5. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
6. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.

## 2.4 CONTINUOUS HINGES

### A. Aluminum Geared

1. Manufacturers:
  - a. Scheduled Manufacturer: Ives.
  - b. Acceptable Manufacturers: McKinney.
2. Requirements:
  - a. Provide aluminum geared continuous hinges conforming to ANSI A156.25, Grade 2.
  - b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum, with 0.25-inch (6 mm) diameter Teflon coated stainless steel hinge pin.
  - c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
  - d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
  - e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
  - f. Provide aluminum geared continuous hinges with electrified option where specified. Provide with sufficient number and gage of concealed wires to accommodate electric function of specified hardware.
  - g. Install hinges with fasteners supplied by manufacturer.
  - h. Provide hinges with symmetrical hole pattern.

## 2.5 ELECTRIC DOOR CORD

- A. Manufacturers:
  - a. Scheduled Manufacturer: Schlage Electronics
  - b. Acceptable Manufacturers: Sargent
- B. Provide power transfer with number and gage of wires sufficient to accommodate electric function of specified hardware.
- C. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

## 2.6 FLUSH BOLTS

- A. Manufacturers:
  - 1. Scheduled Manufacturer: Ives
  - 2. Acceptable Manufacturers: McKinney
- B. Requirements:
  - 1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

## 2.7 MORTISE LOCKS

- A. Manufacturers and Products:
  - 1. Scheduled Manufacturer and Product: Schlage L9000 series
  - 2. Acceptable Manufacturers and Products: Sargent 8200 series
- B. Requirements:
  - 1. Provide mortise locks certified as ANSI A156.13, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
  - 2. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
  - 3. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
  - 4. Provide electrical options as scheduled. Provide electrified locksets with micro switch (RX) option that monitors retractor crank, and is actuated when rotation of inside or

outside lever rotates retractor hub. Provide normally closed contacts or normally open contacts as required by security system.

5. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
  - a. Lever Design: Schlage 06A.
  - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

## 2.8 THREE POINT LOCK

A. Manufacturer and Product: Schlage LM9300. Sargent is acceptable.

B. Requirements:

1. Provide three-point locking system as part of integrated assembly including door, frame, and hardware.
2. Assembly UL approved to FEMA 361 and FEMA 320 guidelines for inswing single, outswing single, and outswing pairs of doors. Must be used with Steelcraft Paladin door.
3. Units to comply with life safety requirements outlined in NFPA 80 and NFPA 101, and approved for use on up to 3-hour fire rated openings.
4. Latchbolt Construction:
  - a. Top Bolt: 5/8 inch (16 mm) Stainless Steel square bolt with 3/4 inch (19 mm) projection. 1/2 inch (13 mm) thick steel top plate. Stainless steel sill strike and fasteners.
  - b. Mortised Center Latchbolt: Two-piece stainless steel anti-friction latch, field reversible without opening case. Fully-wrapped, 12 gauge plated steel lock case. 2-3/4 inches (70 mm) backset. ANSI curved lip strike 1-1/4 inches (32 mm) x 4-7/8 inches (124 mm) with dust box, non-handed.
  - c. Bottom Bolt: 5/8 inch (16 mm) Stainless Steel square bolt with 5/8 inch (16 mm) projection. Stainless steel sill strike and fasteners.
5. Provide sectional or escutcheon trim and function as specified in the hardware sets.

## 2.9 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Von Duprin WS99 series
2. Acceptable Manufacturers and Products: Sargent 80 series

B. Requirements:

1. Assembly UL approved to FEMA 361 and FEMA 320 guidelines for inswing single, outswing single, and outswing pairs of doors. Must be used with Steelcraft Paladin door.

2. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to "KEYING" article, herein.
3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad: Extend minimum of one half of door width. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. Provide compression springs in devices, latches, and outside trims or controls; tension springs also acceptable.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrical requirements.
6. Provide exit devices with manufacturer's approved strikes.
7. Provide exit devices cut to door width and height. Locate exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
8. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
9. Provide cylinder dogging at non-fire-rated exit devices, unless specified less dogging.
10. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
  - a. Lever Style: Match lever style of locksets.
  - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
11. Provide UL labeled fire exit hardware for fire rated openings.
12. Provide electrical options as scheduled.

## 2.10 KEYING

- A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. Keying Requirements – General
  1. Permanent cylinders/cores keyed by the manufacturer according to the following key system.
- C. Keying system as directed by the Owner.
- D. Master Keying System: Cylinders/cores operated by change (day) keys and master key.
- E. Key Features: Provide keys with the following features.
  1. . Patent Protection: Keys and blanks protected by one or more utility patent(s).
- F. Keys
  1. Material: Nickel silver; minimum thickness of .092-inch (2.3mm)



2. Identification:
- G. Coordinate with cylinder/core and key identification requirements above.
- H. Stamp keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
- I. Failure to comply with stamping requirements shall be cause for replacement of keys involved at no additional cost to Owner.
  1. Quantity: Furnish in the following quantities.
    - a. Change (Day) Keys: 3 per cylinder/core.
    - b. Permanent Control Keys: 3.
    - c. Master Keys: 6.
    - d. Unused balance of key blanks shall be furnished to Owner with the cut keys.

## 2.11 DOOR CLOSERS

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: LCN 4010/4110 series
2. Acceptable Manufacturers and Products: Sargent 281/281P10 series factory assembled (without PRV).

### B. Requirements:

1. Provide door closers certified to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter, with 11/16 inch (17 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with a solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

## 2.12 DOOR TRIM

### A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: McKinney.

### B. Requirements:

1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as specified. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.

## 2.13 PROTECTION PLATES

### A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: McKinney.

### B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
  - a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
  - b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
  - c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

## 2.14 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

### A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson

2. Acceptable Manufacturers: Sargent

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

## 2.15 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: McKinney.

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

## 2.16 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: National Guard.
2. Acceptable Manufacturers: Pemko, Zero.

B. Requirements:

1. Provide thresholds, weatherstripping (including door sweeps, seals, astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Size of thresholds:
  - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
  - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width

3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

## 2.17 SILENCERS

### A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: McKinney.

### B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

## 2.18 FINSHES

### A. Finish: BHMA 626/652 (US26D); except:

1. Hinges: BHMA 652 (US26D)
2. Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. 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. Custom Steel Doors and Frames: HMMA 831.
  - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. Lock Cylinders: Install construction cores to secure building and areas during construction period.
- I. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
  - 1. Conduit, junction boxes and wire pulls.
  - 2. Connections to and from power supplies to electrified hardware.
  - 3. Connections to fire/smoke alarm system and smoke evacuation system.
  - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
  - 5. Testing and labeling wires with Architect's opening number.
- J. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.
- K. 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 may impede traffic or present tripping hazard.
- L. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- M. Door Bottoms: Apply to bottom of door to form seal when door is closed.

### 3.3 FIELD QUALITY CONTROL

- A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
  - 1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

### 3.4 ADJUSTING

- A. Initial 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.
  - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately 6 months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

### 3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

### 3.6 DEMONSTRATION

- A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

### 3.7 DOOR HARDWARE SCHEDULE

- A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.
- B. Hardware Sets:

### Hardware Group No. 1

Provide each SGL door(s) with the following:

| Qty |    | Description            | Catalog Number               | Finish | Mfr |
|-----|----|------------------------|------------------------------|--------|-----|
| 1   | EA | CONT. HINGE            | 224HD                        | 628    | IVE |
| 1   | EA | DOOR CORD              | 788C-12                      |        | SCE |
| 1   | EA | ELEC PANIC<br>HARDWARE | WS-CD-9927-L-ER12-E996-06-FS | 626    | VON |
| 1   | EA | RIM CYLINDER           | 20-057                       | 626    | SCH |
| 1   | EA | MORTISE CYLINDER       | 20-061                       | 626    | SCH |
| 1   | EA | SURFACE CLOSER         | 4111 SCUSH                   | 689    | LCN |
| 1   | EA | KICK PLATE             | 8400 10" X 2" LDW B4E        | 630    | IVE |
| 1   | EA | JAMB SEALS             | 160SA                        | AL     | NGP |
| 1   | EA | HEAD SEAL              | 700SA                        | AL     | NGP |
| 1   | EA | DOOR BOTTOM            | 318V                         | AL     | NGP |

### Operational Description:

A remote device will trigger the electronic unlocking of the E996L electrified lever trim in the event of a tornado. No other access control is required.

### Hardware Group No. 2

Provide each SGL door(s) with the following:

| Qty |    | Description    | Catalog Number        | Finish | Mfr |
|-----|----|----------------|-----------------------|--------|-----|
| 1   | EA | CONT. HINGE    | 224HD                 | 628    | IVE |
| 1   | EA | PANIC HARDWARE | WS-9927-L-ER12-996-06 | 626    | VON |
| 1   | EA | RIM CYLINDER   | 20-057                | 626    | SCH |
| 1   | EA | SURFACE CLOSER | 4111 SCUSH            | 689    | LCN |
| 1   | EA | KICK PLATE     | 8400 10" X 2" LDW B4E | 630    | IVE |
| 1   | EA | JAMB SEALS     | 160SA                 | AL     | NGP |
| 1   | EA | HEAD SEAL      | 700SA                 | AL     | NGP |
| 1   | EA | DOOR BOTTOM    | 318V                  | AL     | NGP |

### Hardware Group No. 3

Provide each SGL door(s) with the following:

| Qty |     | Description          | Catalog Number | Finish | Mfr |
|-----|-----|----------------------|----------------|--------|-----|
| 1   | EA  | CONT. HINGE          | 224HD          | 628    | IVE |
| 1   | EA  | MULT PT<br>STOREROOM | LM9080P 06A    | 626    | SCH |
| 1   | EA  | OH STOP              | 100S           | 630    | GLY |
| 1   | EA  | SURFACE CLOSER       | 4011           | 689    | LCN |
| 1   | SET | SEALS                | 700SA          | CL     | NGP |
| 1   | EA  | DOOR BOTTOM          | 318V           | AL     | NGP |

#### Hardware Group No. 4

Provide each SGL door(s) with the following:

| Qty |    | Description    | Catalog Number        | Finish | Mfr |
|-----|----|----------------|-----------------------|--------|-----|
| 3   | EA | HINGE          | 5BB1 4.5 X 4.5 NRP    | 630    | IVE |
| 1   | EA | PUSH PLATE     | 8200 4" X 16"         | 630    | IVE |
| 1   | EA | PULL PLATE     | 8305 10" 4" X 16"     | 630    | IVE |
| 1   | EA | OH STOP        | 90S                   | 630    | GLY |
| 1   | EA | SURFACE CLOSER | 4011                  | 689    | LCN |
| 1   | EA | KICK PLATE     | 8400 10" X 2" LDW B4E | 630    | IVE |

#### Hardware Group No. 5

Provide each PR door(s) with the following:

| Qty |    | Description          | Catalog Number     | Finish | Mfr |
|-----|----|----------------------|--------------------|--------|-----|
| 6   | EA | HW HINGE             | 5BB1HW 5 X 4.5 NRP | 630    | IVE |
| 2   | EA | MANUAL FLUSH<br>BOLT | FB458              | 626    | IVE |
| 1   | EA | DUST PROOF STRIKE    | DP2                | 626    | IVE |
| 1   | EA | CLASSROOM LOCK       | L9070P 06A         | 626    | SCH |
| 2   | EA | WALL STOP            | WS407CVX           | 630    | IVE |

#### Hardware Group No. 6

Provide each SGL door(s) with the following:

| Qty |    | Description    | Catalog Number        | Finish | Mfr |
|-----|----|----------------|-----------------------|--------|-----|
| 3   | EA | HINGE          | 5BB1 4.5 X 4.5 NRP    | 630    | IVE |
| 1   | EA | CLASSROOM LOCK | L9070P 06A            | 626    | SCH |
| 1   | EA | KICK PLATE     | 8400 10" X 2" LDW B4E | 630    | IVE |
| 1   | EA | WALL STOP      | WS407CVX              | 630    | IVE |

#### Hardware Group No. 7

Provide each SGL door(s) with the following:

| Qty |    | Description       | Catalog Number     | Finish | Mfr |
|-----|----|-------------------|--------------------|--------|-----|
| 3   | EA | HINGE             | 5BB1 4.5 X 4.5 NRP | 630    | IVE |
| 1   | EA | MULT PT EXIT LOCK | LM9325 06A         | 626    | SCH |
| 1   | EA | WALL STOP/HOLDER  | WS445              | 626    | IVE |

#### Hardware Group No. 8

Provide each SGL door(s) with the following:

| Qty |     | Description    | Catalog Number | Finish | Mfr |
|-----|-----|----------------|----------------|--------|-----|
| 1   | EA  | CONT. HINGE    | 112HD          | 628    | IVE |
| 1   | SET | PUSH/PULL BAR  | 9190-10"-NO    | 630    | IVE |
| 1   | EA  | SURFACE CLOSER | 4011           | 689    | LCN |
| 1   | EA  | MOUNTING PLATE | 4010-18        | 689    | LCN |
| 1   | EA  | WALL STOP      | WS407CVX       | 630    | IVE |

End Of Section



## SECTION 08 80 00 - GLAZING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. 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. Windows.

#### 1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
  - 1. Human impact loads where required
  - 2. Safety glazing requirements due to location of the glazing.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of the following products; 12 inches square.
  - 1. Insulating glass.
- C. Glazing Accessory Samples: For gaskets, in 12-inch lengths.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: GANA's "Glazing Manual."
  - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
  - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
  - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- F. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- G. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

## 1.8 PROJECT CONDITIONS

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

## PART 2 - PRODUCTS

### 2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - 1. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  - 2. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  - 3. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  - 4. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

## 2.3 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
  - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
  - 2. Spacer: Aluminum with black, color anodic finish .
- B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article.

## 2.4 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

## 2.5 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face

clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

## 2.6 INSULATING-GLASS TYPES

### A. Glass Type: **IGU-A** Low-e-coated, clear insulating glass.

1. Overall Unit Thickness: 1 inch.
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Float glass .
4. Interspace Content: Air.
5. Indoor Lite: Float glass .
6. Low-E Coating: Pyrolytic on second surface.
7. Visible Light Transmittance: 61 percent minimum.
8. Winter Nighttime U-Factor: .29 maximum.
9. Summer Daytime U-Factor: .27 maximum.
10. Solar Heat Gain Coefficient: 0.36 maximum.

### B. Glass type: **LGU** - LAMINATED-GLASS UNITS

1. Overall Thickness: ½" inch
  2. Thickness of Each Glass Lite: 3.175 mm.
  3. Outboard lite: float glass
  4. Plastic Interlayer: Thickness: 0.060 inch, but not less than that required to comply as a Type II safety glass material. Interlayer Color: Clear. Inboard lite: Float glass
- EXECUTION

## 3.1 EXAMINATION

### A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

### B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

### A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

### 3.4 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 80 00

This Page Intentionally Left Blank



## SECTION 09 30 00 - TILING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Ceramic tile.
  - 2. Crack isolation membrane.
- B. Related Sections:
  - 1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

#### 1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
    - a. .
  - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

#### 1.6 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
  - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
  - 1. Crack isolation membrane.
  - 2. Joint sealants.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

## 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

## PART 2 - PRODUCTS

### 2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
  - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

### 2.2 TILE PRODUCTS

- A. Tile Type **CT-1**: Factory-mounted **unglazed** ceramic mosaic tile.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. American Olean; Division of Dal-Tile International Inc.
    - b. Crossville, Inc.
    - c. Daltile; Division of Dal-Tile International Inc.
  - 2. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

- a. Base Cove: Cove, module size 2 by 1 inch.
- b. Base Cap for Portland Cement Mortar Installations: Bead (bullnose), module size 2 by 1 inch
- c. Base Cap for Thin-Set Mortar Installations: Surface bullnose, module size 2 by 2 inches.
- d. External Corners for Thin-Set Mortar Installations: Surface bullnose, module size 1 by 1 inch.
- e. Internal Corners: Cove, module size 2 by 1 inch.
- f. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

B. Tile Type : Glazed wall tile.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
  - a. American Marazzi Tile, Inc.
  - b. American Olean; Division of Dal-Tile International Inc.
  - c. Daltile; Division of Dal-Tile International Inc.
- 2. Module Size: 6 by 6 inches.
- 3. Thickness: 5/16 inch.
- 4. Face: Plain with modified square edges.
- 5. Mounting: Factory, back mounted.
- 6. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
  - a. Base for Portland Cement Mortar Installations: Coved, module size 6 by 6 inches.
  - b. Base for Thin-Set Mortar Installations: Straight, module size 6 by 6 inches.
  - c. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size 6 by 6 inches.
  - d. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
  - e. External Corners for Thin-Set Mortar Installations: Surface bullnose, same size as adjoining flat tile.
  - f. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

C. Accessories: Provide vitreous china accessories of type and size indicated, suitable for installing by same method as adjoining wall tile.

## 2.3 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Bostik, Inc.; Durabond D-222 Duraguard Membrane.
  - b. C-Cure; Pro-Red Waterproofing Membrane 963.
  - c. Custom Building Products; Redgard Waterproofing and Crack Prevention Membrane.
  - d. Jamo Inc.; Waterproof.
  - e. Mer-Kote Products, Inc.; Fracture-Guard 5000.
  - f. Southern Grouts & Mortars, Inc.; Southcrete 1100 Crack Suppression and Waterproofing.
  - g. TEC; a subsidiary of H. B. Fuller Company; HydraFlex - Waterproofing Crack Isolation Membrane.
  - h. .

C. Urethane Crack Isolation Membrane and Tile-Setting Adhesive: One-part, liquid-applied urethane, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), in a consistency suitable for trowel application and intended for use as both waterproofing and tile-setting adhesive in a two-step process.

1. Products: Subject to compliance with requirements, provide the following:
  - a. Bostik, Inc.; Durabond D-200.

## 2.4 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. MAPEI Corporation.
  - b. Mer-Kote Products, Inc.
  - c. Southern Grouts & Mortars, Inc.
  - d. Summitville Tiles, Inc.
  - e. TEC; a subsidiary of H. B. Fuller Company.
2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. Provide prepackaged, dry-mortar mix combined with acrylic resin liquid-latex additive at Project site.
4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

B. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.

## 2.5 GROUT MATERIALS

- A. Standard Cement Grout: ANSI A118.6.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. MAPEI Corporation.
    - b. Southern Grouts & Mortars, Inc.
    - c. Summitville Tiles, Inc.
    - d. TEC; a subsidiary of H. B. Fuller Company.
- B. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

## 2.6 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- C. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Bonsal American; an Oldcastle company; Grout Sealer.
    - b. Bostik, Inc.; CeramaSeal Grout & Tile Sealer.
    - c. C-Cure; Penetrating Sealer 978.
    - d. Custom Building Products; Surfaceguard Sealer.
    - e. Jamo Inc.; Penetrating Sealer.
    - f. MAPEI Corporation; KER 003, Silicone Spray Sealer for Cementitious Tile Grout.
    - g. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
    - h. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.
    - i. TEC; a subsidiary of H. B. Fuller Company; TA-256 Penetrating Silicone Grout Sealer.

## 2.7 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.

- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
  - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  - 2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
  - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
  - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

- D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

### 3.3 TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
  - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
  - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
  - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
  - 1. Ceramic Mosaic Tile: **1/16 inch.**
  - 2. Glazed Wall Tile: **1/16 inch.**
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
  - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.



2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

- I. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### 3.4 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

### 3.5 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
  1. Remove latex-portland cement grout residue from tile as soon as possible.
  2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
  3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

### 3.6 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
  1. Tile Installation F113: Thin-set mortar; TCA F113.
    - a. Thin-Set Mortar: Latex- portland cement mortar.

- b. Grout: Standard sanded cement grout.

B. Interior Wall Installations, Masonry or Concrete:

- 1. Tile Installation W202: Thin-set mortar; TCA W202.

- a. Thin-Set Mortar: Latex- portland cement mortar.

- b. Grout: Standard unsanded cement grout.

END OF SECTION 09 30 00

## SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Related Requirements:
  - 1. Section 095123 "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with concealed suspension systems, stapling, or adhesive bonding.
- C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For components with factory-applied color finishes.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

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

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

## PART 2 - PRODUCTS

### 2.1 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations:
  - 1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
  - 2. Suspension System: Obtain each type from single source from single manufacturer.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- C. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- D. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
  - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.
- E. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
  - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

### 2.2 ACOUSTICAL PANELS APC-1

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Pebble Perforated Model number 2983-- 24x48x5/8 Square lay-in or comparable product by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Color: White .
- C. NRC: Not less than 0.70 .
- D. Edge/Joint Detail: Square .
- E. Thickness: 5/8 inch.
- F. Modular Size: 24 by 48 inches.

## 2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
  - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
  - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Type: Postinstalled expansion anchors.
    - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
    - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
    - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
  - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- diameter wire.

## 2.4 METAL SUSPENSION SYSTEM <Insert drawing designation>

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Prelude 15/16" or comparable product by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. Chicago Metallic Corporation.
  - 3. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 02/11-inch- wide metal caps on flanges.

1. Structural Classification: Intermediate -duty system.
2. End Condition of Cross Runners: butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Steel cold-rolled sheet.
5. Cap Finish: Painted white.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

### 3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post installed anchors.
- C. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- D. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
  1. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

### 3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

This Page Intentionally Left Blank



## SECTION 09 91 13 - EXTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
  - 1. Concrete.
  - 2. Steel.
  - 3. Galvanized metal.
- B. Related Requirements:
  - 1. Section 099123 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

#### 1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

## 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

## 1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. PPG Architectural Finishes, Inc.
  - 3. Sherwin-Williams Company (The).

## 2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
- D. Colors: As selected by Architect from manufacturer's full range.
  - 1. 100 percent of surface area will be painted with deep tones.

## 2.3 METAL PRIMERS

- A. Primer, Alkyd, Anti-Corrosive for Metal:
  - 1.

## 2.4 WATER-BASED PAINTS

- A. Latex, Exterior Low Sheen
  - 1. Sherwin Williams Duration or approved Equal

## 2.5 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
  - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  - 2. Testing agency will perform tests for compliance with product requirements.
  - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.

- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
  - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
  - 4. Paint entire exposed surface of window frames and sashes.
  - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - 1. Paint the following work where exposed to view:
    - a. Metal conduit.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 EXTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
  - 1. High-Build Latex System: Dry film thickness not less than 10 mils.
    - a. Topcoat: Latex, exterior, high build.
- B. Steel Substrates:
  - 1. Water-Based Light Industrial Coating System:
    - a. Prime Coat: Primer, alkyd, anti-corrosive for metal.
    - b. Topcoat: Light industrial coating, exterior, water based, semi-gloss (Gloss Level 5).

END OF SECTION 09 91 13

This Page Intentionally Left Blank

## SECTION 09 91 23 - INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Concrete masonry units (CMU).
  - 2. Steel.
  - 3. Galvanized metal.
- B. Related Requirements:
  - 1. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

#### 1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### 1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Benjamin Moore & Co.
  - 2. Hallman Lindsay Paints.
  - 3. PPG Architectural Finishes, Inc.
  - 4. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, provide product listed in other Part 2 articles for the paint category indicated.

#### 2.2 PAINT, GENERAL

- A. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.



2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

C. Colors: As selected by Architect from manufacturer's full range.

1. 30 percent of surface area will be painted with deep tones.

## 2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: (use on precast panels, CMU, and other similar surfaces.

1. Sherwin Williams      PrepRite Block Filler\_

## 2.4 WATER-BASED PAINTS

A. Latex, Interior, High Performance Architectural, ():

1. Sherwin Williams Duration-satin.

## 2.5 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Masonry (Clay and CMU): 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
    - a. None.
  2. Paint the following work where exposed in occupied spaces:
    - a. Metal conduit.
    - b. Access panels

### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
  2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 09 91 23

## SECTION 10 21 13 - TOILET COMPARTMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Solid-polymer toilet compartments configured as toilet enclosures entrance screens and urinal screens.

- B. Related Sections:

- 1. Section 055000 "Metal Fabrications" for supports that attach to overhead structural system.
  - 2. for overhead support of floor-and-ceiling-anchored compartments.
  - 3. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

- 1. Show locations of cutouts for compartment-mounted toilet accessories.
  - 2. Show locations of reinforcements for compartment-mounted grab bars.
  - 3. Show locations of centerlines of toilet fixtures.
  - 4. Show ceiling grid and overhead support or bracing locations.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to

ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 75 or less.
2. Smoke-Developed Index: 450 or less.

- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" for toilet compartments designated as accessible.

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221.
- C. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

### 2.2 SOLID-POLYMER UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
1. Accurate Partitions Corporation.
  2. Bradley Corporation; Mills Partitions.
  3. Santana Products, Inc.
- B. Toilet-Enclosure Style: Overhead braced.
- C. Entrance-Screen Style: Overhead braced.
- D. Urinal-Screen Style: Wall hung.
- E. Pilaster : Manufacturer's standard design; stainless steel.
- F. Brackets (Fittings):
1. Stirrup Type: Ear or U-brackets, stainless steel.

## 2.3 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
  - 1. Material: Clear-anodized aluminum .
  - 2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
  - 3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
  - 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
  - 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
  - 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

## 2.4 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, in-swinging doors for standard toilet compartments and 36-inch- wide, out-swinging doors with a minimum 32-inch- wide, clear opening for compartments designated as accessible.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch.
    - b. Panels and Walls: 1 inch.
  2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.
    - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

### 3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 21 13



## SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Public-use washroom accessories.
- B. Owner-Furnished Material: Child Changing station.
- C. Related Sections:
  - 1. Accessory schedule on sheet A401

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
  - 1. Construction details and dimensions.
  - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Material and finish descriptions.
  - 4. Features that will be included for Project.
  - 5. Manufacturer's warranty.
- B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.
  - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated.
  - 2. Identify products using designations indicated.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

#### 1.6 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- C. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

#### 2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain one of first two paragraphs and list of manufacturers below. See Section 016000 "Product Requirements."
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. A & J Washroom Accessories, Inc.
  - 2. American Specialties, Inc.
  - 3. Bobrick Washroom Equipment, Inc.
  - 4. Bradley Corporation.
  - 5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
  - 6. Tubular Specialties Manufacturing, Inc.

## 2.3 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

### 3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 28 00

This Page Intentionally Left Blank

## SECTION 10 44 13 - FIRE EXTINGUISHER CABINETS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Related Sections:

- 1. Section 099123 "Interior Painting" for field painting fire protection cabinets.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
  - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
  - 2. Show location of knockouts for hose valves.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

#### 1.5 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.
- C. Coordinate sizes and locations of fire protection cabinets with wall depths.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
- C. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).
- D. Acrylic Bubble: One piece.

### 2.2 FIRE PROTECTION CABINET

- A. Cabinet Construction: Nonrated.
  - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- thick, cold-rolled steel sheet lined with minimum 5/8-inch- thick, fire-barrier material. Provide factory-drilled mounting holes.
- B. Cabinet Material: Steel sheet.
  - 1. Shelf: Same metal and finish as cabinet.
- C. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
  - 1. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- D. Cabinet Trim Material: Steel sheet .
- E. Door Material: Steel sheet.
- F. Door Style: Fully glazed panel with frame .
- G. Door Glazing: Tempered float glass (bronze tint).

- H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
  - 1. Provide recessed door pull and friction latch.
  - 2. Provide concealed hinge permitting door to open 180 degrees.
- I. Accessories:
  - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
  - 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
    - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
      - 1) Location: Applied to cabinet glazing.
      - 2) Application Process: Silk-screened .
      - 3) Lettering Color: White.
      - 4) Orientation: Vertical.
- J. Finishes:
  - 1. Manufacturer's standard baked-enamel paint for the following:
    - a. Exterior of cabinet , door, and trim except for those surfaces indicated to receive another finish.
    - b. Interior of cabinet and door.
  - 2. Steel: Baked enamel or powder coat.

## 2.3 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
  - 1. Weld joints and grind smooth.
  - 2. Provide factory-drilled mounting holes.
  - 3. Prepare doors and frames to receive locks.
  - 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
  - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
  - 2. Miter and weld perimeter door frames.

- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

## 2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.5 STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
  - 1. Color and Gloss: As indicated by manufacturer's designations.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed recessed and semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

### 3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:



1. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
  1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
  2. Provide inside latch and lock for break-glass panels.
  3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

#### 3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 13

This Page Intentionally Left Blank

## SECTION 21 00 00 - FIRE PROTECTION SYSTEM SPECIFICATION

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.
- B. Fire Protection includes wet-pipe sprinkler protection of the entire building. This section includes the following topics:
  - 1. This is a design build project. The contractor shall follow scope documents for type of systems, materials and equipment to use.
  - 2. The contractor shall be the Engineer of Record and prepare, seal and submit drawings and calculations to obtain approval and building permit from State, Insurance company, and local authority. Submit drawings and calculations to authorities. Drawings shall be prepared using AutoCAD, Version 2000 or newer; sheet size shall match size used for Architectural plans.
  - 3. The scope documents, along with local regulations and codes, shall be the basis for the Fire Protection design and construction.
  - 4. The contractor shall calculate, size and select systems as defined by the scope documents. This shall include coordination with other trade contractors.

#### 1.2 GENERAL PROVISIONS

- A. The fire standpipe and sprinkler systems shall be designed and installed in conformance with NFPA 13, Wisconsin Building Code and Fire Code for City of Madison.
- B. Fees, permits and inspections shall be obtained and paid for by the Fire Protection Contractor.
- C. Verify the location and size of the water service.
- D. Include costs to cut and patch walls, floors, roof, and ceiling, affected by new work.
- E. Installation shall be warranted for one year after date of acceptance.
- F. Power, control, and alarm wiring shall be by Electrical Contractor and coordinated with Electrical Contractor.
- G. Keep premises free from waste materials during construction .
- H. Pipe sleeves or openings shall be set for pipes passing through new masonry or concrete walls and floors. Sleeves for piping at exterior penetrations above and below grade shall be Schedule 40 black steel pipe and shall extend through the construction. Provide flanges for supporting sleeves through existing construction as applicable.
- I. The annular space between drilled or sleeved holes and pipes passing through exterior walls or below grade foundation walls shall be sealed with a "Link-Seal" as manufactured by the Thunderline Corporation. "Link-Seal" shall consist of ASTM D2000 EPDM rubber compound interlocking links, Delvin pressure plates and corrosion resistant fasteners. Provide schedule 40 pipe sleeve with anchor collar at wall penetration.

- J. Coordinate the location of sleeves, openings, chases, and furred spaces, with the other Contractors. Provide sleeves, hangers and inserts that are to be built into the structure during the progress of construction.
- K. Sleeves shall extend 1 inch above the finished floor. In mechanical rooms and other areas where water may accumulate, sleeves shall extend 2 inches above the finished floor.
- L. Grout openings through concrete or masonry, including space between sleeves and walls of floors, with Dow 8640 or 8641 sealant.
- M. Piping penetrating smoke or fire separations shall not violate the integrity of the separation. Where penetrations occur through fire rated walls or floors, "Link-Seal Pyro-Pac" shall be used, which is rated for 3 hour fire resistance by ASTM E-119-76. "Pyro-Pac" shall consist of two individual sealing units consisting of fire-resistant silicon links, steel pressure plates, and corrosion resistant fasteners.
- N. The space above suspended ceilings may be return plenum to move air to the Air Handling Units. Properly protect plastic and other combustible materials installed in the plenum space.
- O. Provide pipe hangers or strut connected to structural elements to support piping. Space hangers per NFPA 13.

### 1.3 UNIT PRICES

- A. When submitting his cost for the project the contractor shall provide a list of man hour rates. These rate prices shall reflect the cost the contractor will either add or deduct from his base price, where the Owner decides to install or delete systems, piping, or equipment on an individual basis.

### 1.4 OCCUPANCY REQUIREMENTS

- A. Contractor shall verify the planned occupancy and phasing of the building with the Architect and Owner prior to design and construction. Contractor pricing shall reflect these requirements to the extent that fire protection systems must be installed, located, segregated, operational, or otherwise planned to reflect phasing and partial occupancy requirements.
- B. Coordinate disruptions for piping installation and system shut-down requirements with existing tenants and with the building Owner.

### 1.5 DESIGN CRITERIA

#### A. SPRINKLER SYSTEM

- 1. Common Areas:
  - a. Light Hazard coverage.
  - b. Density - 0.10 gal/min/ft<sup>2</sup>.
  - c. Area - 1500 ft<sup>2</sup>
  - d. Hose Allowance - 250 gal/min
  - e. Maximum Velocity - 20 feet/sec
  - f. Duration of Water Supply - 60 minutes
- 2. Mechanical and Storage Rooms:
  - a. Ordinary Hazard, Group 1 coverage

- b. Density - 0.15 gal/min/ft<sup>2</sup>.
- c. Area - 1500 ft<sup>2</sup>
- d. Hose Allowance - 250 gal/min
- e. Maximum Velocity - 20 feet/sec
- f. Duration of Water Supply - 60 minutes

## 1.6 SYSTEM DESCRIPTION

- A. Provide a double check valve assembly and fire department connection. Extend piping to the wet sprinkler system to provide coverage in the entire building. Provide a flow switch and valves with tamper switches.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Items shall be UL listed or FM approved for the intended usage.

### 2.2 PIPE AND FITTINGS

- A. Carbon steel pipe, black, thickness per NFPA 13, conforming to ASTM A53, A135, A795. Malleable iron fittings, screwed or mechanical coupling joints.

### 2.3 CROSS CONNECTION CONTROL DEVICE

#### A. MANUFACTURERS

- 1. Cla-Val, Conbraco, Febco, Watts (Ames), or Wilkins.

#### B. DOUBLE DETECTOR CHECK VALVE

- 1. Stainless steel, double cam-check assemblies, bypass meter (per Water Utility requirements), conforming to ASSE 1048, UL Listed, FM approved, Watts/Ames Model 3000ss.

### 2.4 VALVES

#### A. MANUFACTURERS

- 1. Central, Grinnell, Nibco, Victaulic, or Wilkins.

#### B. SHUTOFF VALVE

- 1. Butterfly valve: Ductile iron body, epoxy coated, EPDM encapsulated ductile iron disc, 300 psi maximum working pressure, indicating type, with tamper switch in actuator, grooved end connections, UL Listed or FM approved, Victaulic Figure 705-W.

#### C. CHECK VALVE

- 1. Ductile iron body, rubber-encapsulated disc, 250 psi maximum working pressure, grooved end connections. Victaulic style 717.

#### D. TEST DRAIN VALVE

- 1. Ball valve type, bronze, combination test and drain, with site glass, Sure-Test by G/J Innovations.

## 2.5 FLOW SWITCHES

- A. UL listed and FM approved vane type waterflow switch with metal enclosure, adjustable pneumatic retard and electrical characteristics compatible with alarm system. Equal to Potter Model VSR-F.

## 2.6 TAMPER SWITCHES

- A. For O S & Y valve or post indicator installations, UL listed, FM approved, to monitor position of valve, tamper resistant cover screws, single or double SPDT switch contacts, corrosion resistant, for indoor or outdoor use, NEMA 4 & 6P enclosures. Equal to Potter Model PCVS-1, -2 and OSYSU-1, 2.

## 2.7 SPRINKLERS

### A. MANUFACTURERS

1. Central Sprinkler, Grinnel, Reliable, Star Sprinkler, Tyco, or Viking.
2. Provide upright or pendant heads, brass, glass bulb actuator, residential and quick response type. Temperature ratings shall comply with Insurance company recommendations. Finished rooms with ceilings shall be concealed sprinklers. Coordinate sprinkler finishes with Architect.
3. Provide mechanical guards and high temperature sprinkler heads in elevator shaft and in mechanical rooms. Provide mechanical guards on sprinkler heads in storage areas and below ductwork or equipment in storage and mechanical spaces.

### B. Finished Areas

1. Chrome plated bronze body quick response pendent, concealed, or side-wall sprinklers with glass bulb heat sensor. Semi-recessed and sidewall sprinklers shall have adjustable recessed escutcheon. Concealed sprinklers shall have adjustable cover plates.

### C. Unfinished Areas

1. Plain bronze body, upright or pendent, quick response sprinklers, with solder link or glass bulb for wet system. Plain bronze, upright or pendent open sprinkler for dry system.

### D. RATINGS

1. Use ordinary temperature sprinkler heads in most spaces unless noted otherwise. Use higher temperature-rated sprinkler heads in areas near heat sources.

## 2.8 FIRE DEPARTMENT CONNECTION

- A. Wall mounted Siamese type, cast brass construction with pin lug swivel plugs labeled "AUTO SPRINKLER/ STANDPIPE" with drop clappers, threads to match local fire department and polished chrome or polished brass finish to match building color scheme. Potter-Roemer 5020/ 5750 Series.
- B. Mounting height, and distance from curb, shall be as specified by local fire department.

## 2.9 LOCAL ALARM BELL

- A. UL listed and FM approved weatherproof electric alarm bell with red painted metal housing, mounting base and gong, solenoid operator, weatherproofing O-ring seal and electrical characteristics compatible with alarm system. Equal to Potter Model PBA.

## 2.02 MISCELLANEOUS EQUIPMENT

- A. Provide other equipment and accessories, for a sprinkler system installation in accordance with NFPA and FM requirements.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Design and install sprinkler system in conformance with requirements of NFPA 13, Wisconsin Building Code, Insurance regulations, and Local Fire Marshal Regulations.
- B. Provide pressure and flow tests as required by NFPA and insurance company. Inform Owner, Architect, and Local Fire Department one day prior to performing the test so that if anyone desires, they may witness the test.

### 3.2 GENERAL

- A. Install piping parallel to building walls and ceilings and at heights which do not obstruct windows, doorways, stairways, or passageways. Where interferences develop in the field, offset or reroute piping to clear interferences. Coordinate locations of fire protection piping with piping, ductwork, conduit and equipment of other trades to allow clearances. Consult drawings for exact location of pipe spaces, ceiling heights, ceiling grid layout, light fixtures and grilles before installing piping. Exposed overhead piping shall be installed above the bottom chord of roof joists.
- B. Maintain piping in clean condition internally during construction.
- C. Provide clearance for access to valves and piping specialties.
- D. Install piping so that system can be drained. Where possible, slope to main drain valve. Piping may be installed level. (WET SYSTEMS ONLY). Where piping cannot be drained, install nipple and cap for drainage of less than 5 gallons or valve/nipple/cap for drainage over 5 gallons. Pipe inspector's tests and auxiliary drains to grade.
- E. Do not install piping within exterior walls.
- F. Do not route piping above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

### 3.3 VALVES

- A. Properly align piping before installation of valves. Do not support weight of piping system on valve ends. Mount valves in locations which allow access for operation, servicing and replacement. Install valves with the stem in the upright or horizontal position. Valves installed with the stems down shall not be accepted. Shut-off valves shall have a supervisory switch.

#### 3.4 GAUGES

- A. Provide a valved pressure gauge in main sprinkler risers.

#### 3.5 SWITCHES

- A. Provide valved test connection for flow switch adjacent to flow switch. Test flow switch to verify proper operation.

#### 3.6 SPRINKLERS

- A. Locate sprinklers maintaining clearances from obstructions, ceilings and walls. Install sprinklers level in locations not subject to spray pattern interference.
- B. Sprinklers shall be centered in ceiling panels and tiles. A 1" tolerance for sprinkler placement is acceptable.

#### 3.7 FIRE DEPARTMENT CONNECTION

- A. Support from structure independent of piping. Locate 24" above grade or in compliance with local Fire Marshall standards. Fill wall penetration with insulation and caulk exterior and interior face of wall opening weather tight.

END OF SECTION



## SECTION 22 01 00 - OPERATION AND MAINTENANCE OF PLUMBING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 COORDINATION

- A. The Drawings show the general arrangement of piping and equipment and shall be followed as closely as actual building construction and the work of other trades permits. Architectural and Structural Drawings shall take precedence. Because of the scale of the Drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate conditions affecting the Work and arrange accordingly, providing offsets, fittings and accessories as may be required to meet conditions.

#### 1.3 LEAD FREE REQUIREMENTS

- A. 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 of less than or equal to 0.25% per the Federal Safe Drinking Water Act as amended January 4, 2011, Section 1417.
- B. This requirement applies to all of the subsequent Plumbing Specifications Sections and Plumbing Drawings and supersede any part or model number that may conflict with this requirement.

#### 1.4 QUALITY ASSURANCE

- A. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.
- B. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed.
- C. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are familiar with the specified requirements and the methods needed for proper performance of the work.
- D. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the project. Work performed that does not comply with the project requirements, without having notified the A/E, shall be corrected without additional cost to the project.

#### 1.5 REGULATORY REQUIREMENTS

- A. CODES AND STANDARDS

1. Plumbing work shall conform to the requirements of Wisconsin Administrative Code SPS 382 and SPS 384, Wisconsin Plumbing Code.
  2. Materials and workmanship shall comply with applicable Codes, local ordinances, industry standards and utility regulations. In case of differences between Codes, and the Contract Documents, the most stringent shall govern.
- B. Permits, Inspections and Fees
1. Request and obtain permits and inspection appointments.
  2. Provide fees and charges for approvals, reviews, and other inspections.
  3. Provide fees and charges assessed by local utilities for water, sewer, gas or other services.
- 1.6 ABBREVIATIONS AND SYMBOLS
- A. Key to abbreviations and symbols shall be on the Drawings.
- B. The following are additional abbreviations used in the Specifications:
1. A/E Architect/Engineer
  2. GC General Contractor
  3. PC Plumbing Contractor
  4. FPC Fire Protection Contractor
  5. HC Heating Ventilating and Air Conditioning Contractor
  6. EC Electrical Contractor
- 1.7 REFERENCE STANDARDS
- A. Standards cited in the Specifications shall be the most recent editions of the following:
1. AGA American Gas Association
  2. ANSI American National Standards Institute
  3. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
  4. ASPE American Society of Plumbing Engineers
  5. ASSE American Society of Sanitary Engineers
  6. ASME American Society of Mechanical Engineers
  7. ASTM American Society of Testing and Materials
  8. AWWA American Water Works Association
  9. CGA Compressed Gas Association
  10. CISPI Cast Iron Soil Pipe Institute
  11. FM Factory Mutual System
  12. FS Federal Specifications
  13. MSS Manufacturers Standardization Society
  14. NBS National Bureau of Standards
  15. NEC National Electric Code (NFPA 70)
  16. NEMA National Electric Manufacturers Association
  17. NFPA National Fire Protection Association
  18. NSF National Sanitation Foundation
  19. NSPI National Spa and Pool Institute
  20. PDI Plumbing and Drainage Institute
  21. UL Underwriter's Laboratories, Inc.
  22. WCF Water Conditioning Foundation
- 1.8 SUBMITTALS
- A. Submit shop drawings with space for approval stamps of GC and A/E.

- B. Furnish a separate, typed list showing fixture designation, manufacturer, model number and additional items supplied with fixture, as in sample entry below.
  - 1. Lavatory L-1
  - 2. Lavatory Kohler K-1234
  - 3. Faucet Chicago Faucet Co. No. 123
  - 4. Stop/Supplies Chicago Faucet No. 1234
  - 5. Waste/Trap 1½" size, McGuire #123

#### 1.9 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Upon completion of the work, but before acceptance of the system, instruct the Owner's designated employees on care and operation.
- B. Prepare and deliver to the A/E two (2) hard cover ring type binders entitled "Operating and Maintenance Manual" for equipment on the project. Each book shall include:
  - 1. Index
  - 2. Separate sections with tabs keyed to Index
  - 3. Warranties
  - 4. Manufacturer's instructions for installation, maintenance and operation
  - 5. Spare parts list
  - 6. Final approved shop drawings
  - 7. Diagram and typewritten narrative of operation for equipment and systems
  - 8. One-line wiring diagrams with schematics on a single sheet
  - 9. Start-up reports
  - 10. Valve schedules

#### 1.10 TESTING

- A. Provide materials, labor, and equipment required for testing.
- B. Notify Inspector(s) one day prior to the time when the test is ready to be performed.
- C. After testing, submit in writing the time, date, name and title of the person approving the test. This shall also include the description and what portion of the system has been tested. The person approving the test shall sign the submittal.
- D. Records shall be maintained of testing that has been completed, and shall be made available at the job site.
- E. Upon completion of the work, records and certifications approving testing requirements shall be submitted.
- F. Defective work or material shall be replaced or repaired, and the test repeated. Repairs shall be made with new materials.

#### 1.11 CLEANING

- A. Keep the premises broom clean and free of surplus materials, rubbish and debris.
- B. After fixtures and equipment have been installed, remove stickers, rust stains, labels, and temporary covers.
- C. Foreign matter shall be blown out, or flushed out, of pipes, tanks, pumps, strainers, motors, devices, switches, fixtures, and panels.

- D. Water Heaters shall be cleaned, drained, flushed and re-cleaned until free of oil and debris.
- E. Identification plates on equipment shall be free of paint and dirt.
- F. Leave the work in a condition ready for operation.

#### 1.12 RECORD DOCUMENTS

- A. See Division 1.

#### 1.13 WARRANTY

- A. Warrant that work shall function for one year immediately following acceptance of the system(s).
- B. Keep the system in good working order at no expense, unless defects are clearly the result of improper or abnormal usage.
- C. Submit for acceptance of the work, written certification that the entire system has been installed and adjusted for operation in accordance with the Contract Documents.

#### 1.14 CERTIFIED STARTUP REPORTS

- A. The Contractor shall obtain from the manufacturer of equipment in the following systems, four (4) copies of certified startup reports prepared and signed by the manufacturer's representative in responsible charge. The four copies of the startup reports shall be submitted to the A/E along with or prior to the Contractor's certification of completion. The following systems require manufacturer's startup reports:
  - 1. Water Treatment Systems
  - 2. Water Heaters

END OF SECTION

## SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUBMITTALS

- A. Submit product data sheets in accordance with Division 1 and Section 22 01 00.

### PART 2 - PRODUCTS

#### 2.1 PIPE SUPPORTS, HANGERS AND INSERTS

##### A. ACCEPTABLE MANUFACTURERS

- 1. B-Line, Fee and Mason, Grinnell, Michigan Hanger, PHD Manufacturing, Powers/Rawl, Proset, Unistrut, or Victaulic.

##### B. GENERAL

- 1. Secure pipe in place to prevent vibration, maintain proper slope and provide for expansion and contraction.
- 2. Design supports of strength and rigidity to suit loading, service, and manner which do not unduly stress the building construction. Where support is from concrete construction, take care not to weaken concrete or penetrate waterproofing. Fasten supports and hangers to building steel framing wherever practical. Do not use another pipe for support. Do not use perforated iron, chain or wire as hangers.
- 3. Use inserts for suspending hangers from reinforced concrete slabs wherever practical. Where inserts are not practical, provide channels or angles from which to suspend hangers/supports. Fasten structural steel to concrete with expansion bolts.
- 4. Provide expansion anchors in concrete slabs for installation of threaded support rods.
- 5. Provide hangers capable of vertical adjustment after piping is erected. Do not pierce ductwork with hanger rods. On threaded support rods and bolts, weld nuts to rods, peen threads, or provide double set of nuts with lock washers to prevent loosening. Use beam clamps for attaching hangers to structural steel.
- 6. On piping insulated with vapor barrier covering, use protection shield to cover bottom one-half of insulated pipe. Shield to be a minimum of 12" long and of 16 gauge galvanized steel.
- 7. Submit anchor drawings for approval upon request.
- 8. Hangers, supports, and support methods other than those specified shall not be used without obtaining approval on method of support by the Structural Engineer prior to installing piping systems. Submit support method arrangement, pipe weight and spacing scheme for approval.

##### C. SUPPORT SPACING

- 1. Support horizontal piping per following table:

| Pipe Size  | <u>Max Span (Feet)</u> |        |       |
|------------|------------------------|--------|-------|
|            | Rod Diameter           | Copper | Steel |
| Up to 1¼"  | 3/8"                   | 6      | 8     |
| 1½" and 2" | 3/8"                   | 10     | 10    |
| 2½" and 3" | 1/2"                   | 10     | 12    |
| 4" and 5"  | 5/8"                   | 10     | 12    |

2. Support cast iron No-Hub pipe as recommended in CISPI Publication "Suggestions for Cast Iron No-Hub Pipe and Fittings". Rod diameter shall be as for steel pipe.
3. Support horizontal lines of PVC pipe with hangers, spaced not more than 3 feet on center at branch ends and changes of direction. Rod diameter shall be as for steel pipe.
4. For piping that does not pass through the floor, provide adequate support to stabilize the vertical portion of the piping.
5. Provide galvanized steel supports for cast iron and steel piping.
6. Provide PVC dipped hangers or provide Unistrut "Uni-Cushion" vinyl strip at galvanized hangers for copper lines.

D. OVERHEAD SUPPORTS

1. Adjustable clevis hanger, steel, Dura-Green epoxy coating or electro-plated, B-Line Figure B3100.
2. Adjustable J hook hanger, steel, Dura-Green epoxy coating or electro-plated, B-Line figure B3690.
3. Adjustable band hanger, steel, Dura-Green epoxy coating or electro-plated, B-Line Figure B3172.

E. VERTICAL SUPPORT

1. Riser clamp, steel, Dura-Green epoxy coating or electro-plated, B-Line Figure B3373.
2. Riser clamp, flexible sleeve with stainless steel band, Proset PS #33.

F. STRUT

1. Where several pipes are running parallel and pitching in the same direction, strut style support may be used. Steel channel, 12-gauge thickness, Dura-Green epoxy coating or electro-plated, B-Line B11. Restrain insulated pipes with B-Line B2000 series strut clamps. Restrain un-insulated pipes with Vibraclamp BVT/BVP series strut clamps.

G. HANGER ROD

1. Steel, electro-plated, threads on both ends, B-Line B3205.

H. INSERT

1. Concrete expansion insert, drop-in style, steel material, minimum tension load of 3200 pounds, Powers/Rawl.

2.2 ELECTRICAL REQUIREMENTS

A. GENERAL

1. Work shall conform to requirements of Division 16.
2. Power wiring shall be provided by the EC. Control wiring shall be provided by the PC. Plumbing Contractor shall provide wiring diagrams for use by the Electrical Contractor.

**B. MOTORS**

1. Motors smaller than ½ HP shall be NEMA standard motors rated for 120 volts, AC, single phase, 60 Hz. Motors shall be capacitor start and capacitor run type and shall have internal overload protection.
2. Motors ½ HP and larger shall be NEMA standard motors rated for specified voltage, AC, three phase and 60 Hz.
3. Motors shall be Design B, squirrel cage, open drip-proof construction with standard T frame, ball bearings, Class B insulation, single winding, continuous duty rated and 1.15 service factor unless noted otherwise.
4. Minimum power factor for motors one HP and larger is 85% at rated capacity. Capacitors for power factor correction are not acceptable.
5. Provide devices for motor overload protection unless integral with equipment. Devices shall be sized according to actual measured current draw with motor operating under normal load conditions. Provide temporary protective devices where installation is not complete.

**C. MOTOR STARTERS**

1. Motor starters shall be provided by the PC.
2. Provide a combination starter for each motor.
3. Starter shall conform to Allen-Bradley Co. Bulletin 512, consisting of a Bulletin 509 full voltage starter and non-fusible disconnect switch mounted in a NEMA Type 1 general purpose enclosure.
4. Starter shall be equipped as standard with block type overload relays and external reset buttons.
5. Starter shall be equipped as standard with a transformer to provide a 120V, 60 Hz., secondary control circuit.
6. Provide a three position Hand-Off-Auto selector switch for field installation in the enclosure flange: A-B Catalog No. 1481-N51A or 1481-N51B.

**2.3 EQUIPMENT ACCESSORIES**

- A. Provide equipment accessories, connections and incidental items.
- B. Install piping connecting to pumps and other equipment without strain at the piping connection. If requested by the A/E, remove the bolts in these flanged connections, or disconnect piping, to demonstrate that piping has been properly connected.

**2.4 EQUIPMENT SUPPORT**

- A. Examine Drawings, and manufacturer's data to determine how equipment, fixtures, and piping are to be supported, mounted or suspended. Support all equipment plumb, rigid, and true to line. Provide rods, bolts, inserts, pipe stands, brackets and accessories for proper support.

**2.5 THERMOMETERS AND GAUGES**

**A. ACCEPTABLE MANUFACTURERS**

1. American, Taylor, Trerice, U.S. Gauge, or Weiss.

**B. THERMOMETERS**

1. Industrial type with separable sockets, adjustable angles, black cast aluminum 9" case, frame, glass front, with red appearing mercury tube. Readable by person standing on floor. Provide extension necks for equipment with 2" or thicker insulation. Ranges shall be as follows:

- a. Domestic Water: 30 to 200 degrees Fahrenheit.
- C. PRESSURE GAUGES
  - 1. Industrial quality with phosphor bronze bourdon tube, brass socket, 3½ inch dial face, bronze bushed movement, aluminum case with black finish, white background, black figures readable by person standing on floor. Ranges shall be as follows:
    - a. Domestic Water: 0 to 150 psig
  - 2. Pressure Snubbers: Brass or stainless steel construction, 300 psig working pressure.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. COORDINATION OF WORK
  - 1. Review the Drawings and Specifications and report discrepancies. Obtain written instructions for changes necessary. Coordinate with each trade prior to beginning installation and make provisions to avoid interferences. Changes required caused by neglect to coordinate shall be made without expense to the project.
  - 2. Piping shall not be located above electrical panels.
- B. ANCHOR BOLTS, SLEEVES, AND SUPPORTS
  - 1. Anchor bolts, sleeves, and supports shall be provided for installation of piping and equipment. They shall be installed by the trade furnishing and installing the material. Location of anchor bolts, sleeves, and supports shall be directed by the trade requiring them.
- C. OPENINGS, CUTTING AND PATCHING
  - 1. Provisions for openings including chases, holes and clearances through walls, floors, and roof, ceilings and partitions shall be made in advance of construction of each part of the building. Openings shall be provided by the GC for the respective materials in which openings occur, during the construction of the building with the exception of pipe sleeves. The PC shall furnish to the GC opening dimensions and locations.
  - 2. If the PC neglects to inform the GC of his opening requirements before that portion of the building construction is complete, the PC shall cut the openings and provide framing and lintels. In the event holes must be cut through reinforced concrete, avoid spalling and unnecessary damage or weakening of structural members. No chopping or breaking out is permitted. Before cutting or drilling, obtain permission from the A/E. Patch adjacent materials and repair damage resulting from the cutting.
  - 3. Framed openings shall be by the GC.
- D. ADJUSTMENTS IN LOCATIONS
  - 1. Locations of pipes, fixtures, and equipment shall be adjusted to accommodate the work interferences anticipated and encountered. Prior to fabrication, determine the exact route and location of each pipe.
- E. RIGHT OF WAY
  - 1. New lines which pitch shall have the right-of-way over those which do not pitch. Gravity drains shall normally have right-of-way. Lines whose elevations cannot



be changed shall have the right-of-way over lines whose elevations can be changed.

2. Offsets, transitions and changes in direction of electrical raceways, pipes and ducts shall be made to maintain proper room and pitch of sloping lines whether or not indicated on the Drawings. Provide traps, air vents, and sanitary vents, per code, to affect the offsets, transitions and changes in direction.

### 3.2 PIPING INSTALLATION

#### A. GENERAL

1. Expansion and contraction of piping shall be provided for by expansion loops, bends, swing joints, or expansion joints to prevent damage to connections, piping, and equipment of the building.
2. Unions or flanges shall be installed on by-passes, ahead of traps, adjacent to screw connection valves, and at connections to equipment.

#### B. INSTALLATION ARRANGEMENT

1. Install work to permit removal (without damage to other parts) of parts requiring replacement or maintenance. Arrange pipes and equipment to permit ready access to valves, cocks, traps, starters, motors, control components and to clear the openings of swinging and overhead doors and of access panels.

#### C. CONNECTIONS DIFFERENT FROM THOSE SHOWN

1. Where equipment requiring different arrangement or connections from those shown is used, install the equipment to operate properly and in harmony with the intent of the Drawings and Specifications. When requested by the A/E, submit drawings showing the proposed installation.
2. Upon approval of the revisions, make changes in piping, ductwork, supports, insulation, wiring, and panelboards. Provide additional motors, controllers, valves, fittings and other additional equipment required for the proper operation of the system resulting from the selection of equipment, including required changes in affected trades
3. Changes shall be made at no increase in the Contract amount or additional cost to the other trades.

### 3.3 LUBRICATION AND MAINTENANCE

- A. Equipment shall be properly cared for, lubricated and adjusted before it is placed in operation. Equipment shall be maintained properly and lubricated until building is accepted.

### 3.4 FLOOR, WALL AND CEILING OPENINGS

- A. Pipe sleeves shall be set for pipes passing through new masonry or concrete walls or floors and interior partition walls.
- B. Coordinate the location of sleeves, openings, chases and furred spaces with the other Contractors. Provide during the progress of construction sleeves, hangers and inserts that are to be built into the structure.
- C. Sleeves for piping at exterior penetrations above and below grade shall be Schedule 40 black steel pipe and shall extend through the construction. Provide flanges for supporting sleeves through existing construction as applicable.

- D. Sleeves for horizontal piping at interior partition penetrations shall be 24-gauge sheet metal, closed with snap lock joint or welded longitudinal seam.
- E. Sleeves for pipe 4" and smaller shall be at least two pipe sizes larger than the pipe passing through. Sleeves for pipe larger than 4" shall be at least one pipe size larger than pipe passing through. Sleeves for insulated piping shall be 1" larger in diameter than the insulated pipe.
- F. Piping penetrating smoke or fire separations shall not violate the integrity of the separation.
- G. When plastic waste and vent piping is used and penetrates a rated fire separation, provide steel sleeves and UL listed intumescent fire rated sealant.
- H. Grout between sleeves and openings through concrete or masonry walls or floors, with Dow 8640 or 8641 sealant.
- I. The annular space between drilled or sleeved holes and pipes passing through exterior walls or below grade foundation walls shall be sealed with a "Link-Seal" as manufactured by the Thunderline Corporation. "Link-Seal" shall consist of ASTM D2000 EPDM rubber compound interlocking links, Delvin pressure plates and corrosion resistant fasteners. Provide schedule 40-pipe sleeve with anchor collar at wall penetration.
- J. Where penetrations occur through fire rated walls or floors, "Link-Seal Pyro-Pac" shall be used, which is rated for 3-hour fire resistance by ASTM E-119-76. "Pyro-Pac" shall consist of two individual sealing units consisting of fire-resistant silicon links, steel pressure plates, and corrosion resistant fasteners.

### 3.02 ESCUTCHEON PLATES

- A. Provide plates on pipes passing through finished floors, walls and ceilings, with outside diameter to cover sleeve opening and inside diameter to fit snugly around pipe. Set tight to building surface. Escutcheon plates shall be chromium plated metal.

### 3.5 EQUIPMENT, PIPING AND VALVE IDENTIFICATION

#### A. EQUIPMENT LABELS

- 1. After painting and covering, identify equipment, including pumps, water heaters, tanks, compressors, and control panels. Locate identification as conspicuously as possible.
- 2. Identification of equipment shall be by engraved white letters on a black plastic panel, permanently attached to the equipment.

Minimum size: 3/4" x 2 1/2" with 3/8" letters.

#### B. PIPE IDENTIFICATION

- 1. Pipe identification shall conform to ANSI A13.1 "Scheme for Identification of Piping Systems".
- 2. Printed labels identifying the fluid conveyed and direction of flow shall be attached to pipes in accessible locations, at intervals not to exceed 20 feet, not less than once in each room, at each branch, adjacent to each access door or panel, at each valve and where exposed piping passes through walls and floors.

Outside Diameter of  
Pipe Covering

Minimum Size of Letters

up to 1¼"

½"

1½" to 2"

¾"

2½" to 6"

1½"

3. Non-potable water piping, valves and outlets shall be labeled in accordance with Local and State Plumbing Codes.

C. VALVE TAGS

1. Identify each valve by means of 1½" diameter brass tag fastened to body of valve with copper or brass chain. Identification number shall be stamped thereon with letters a minimum of ½" high. The following prefixes shall be used: PLBG - Plumbing.

D. VALVE CHARTS

1. Furnish three charts listing each valve. Two charts shall be delivered to A/E. An additional chart shall be framed behind glass and hung in location selected by Owner. Charts shall show the following:
- |                 |               |
|-----------------|---------------|
| Valve number    | Size          |
| Manufacturer    | Type of valve |
| Type of service | Location      |
2. Furnish a typewritten chart indicating equipment or areas served by each numbered valve and incorporate in Operating and Maintenance Manuals.

3.6 ACCESS PANELS

- A. Provide access panels at locations requiring access to mechanical equipment, valves, devices, and accessories. These locations include, but are not limited to areas above drywall ceilings, shaft enclosures and other furred-in spaces concealing valves, ducts or other equipment. Provide UL listed fire rated access panels when penetrating fire rated chases or shaft areas.
- B. Access panels shall be of size required to provide adequate access to equipment. Minimum size shall be 12"X12" for hand access and 24"X24" for body access.
- C. Panels shall be Milcor brand, or equivalent.
- D. Panels shall include concealed hinges, cam type locking devices, and have a frame/border type necessary for the particular wall or ceiling construction in which they are installed. Access panels shall be flush mounted, recessed frame type units. For general applications, access panels shall be field paintable prime coated steel. For toilet rooms, shower rooms and similar wet areas, access panels shall be stainless steel.
- E. Refer to architectural room finish schedule for wall and ceiling surfaces and finishes.
- F. Panel construction shall utilize a 16 gauge frame with not less than a 18 gauge hinged door panel. Door locks shall be screwdriver operated for panels in general location applications and shall be key locked for public area applications.

3.7 CONCRETE PADS, CURBS, SUPPORTS AND BALLAST

- A. Provide concrete equipment pads for floor-mounted equipment. Minimum 3½" thick, sized for purpose intended. Equipment pads shall extend six inches beyond edge of equipment footprint.

- B. Provide 3½" high concrete curbs around pipe and equipment sleeves in suspended slabs. Curbs shall prevent water leaks around sleeves.
- C. Concrete work shall conform with Division 3.
- D. Provide structural steel stands or supports for equipment requiring support. Steel work shall conform to Division 5.

### 3.8 FLASHING OF ROOF AND WALL PENETRATIONS

- A. Flashings on the roof shall be closely coordinated. Install flashings to insure proper vapor barrier.
- B. Flash open piping (example: plumbing vents) with sheet lead turned down 1" into pipe.
- C. Plumbing vents through roof shall be flashed and counterflashed to conform with details recommended by roof system manufacturer. See roofing specifications for specified system. Provide additional sheet lead, membrane layers and sealant to insure waterproof installation
- D. Roof attachments, equipment supports, piping systems and other roof penetrations shall be waterproofed.
- E. Install premolded fabric boot flashings with vent cap for vents through roof as recommended by the manufacturer. Include roof mastic and elastomer.

### 3.9 PAINTING

- A. Refer to Division 9.

### 3.10 EXCAVATION AND TRENCHING

#### A. GENERAL

1. Become familiar with soil conditions affecting excavation and trenching. Obtain a copy of the soils report and take note of underground conditions, including water level.
2. Provide excavation required to the depths indicated. During excavation, backfill material shall be piled in an orderly manner at a distance from the trench to avoid overloading and to prevent slides or cave-ins. Provide proper disposal of debris and excavated materials not required or not acceptable for backfill.
3. Grading shall be done as needed to prevent surface water from flowing into trenches or excavations.
4. Sheeting or shoring shall be provided for the protection of the work and for the safety of personnel.
5. Excavation shall be by open cut except that short sections of a trench may be tunneled with prior approval of the A/E. Each excavation shall include clay, silt, sand, rock mulch, gravel, hardpan, loose shale, loose stone, and other materials.
6. Open trench ahead of pipe laying to reveal obstructions.
7. Provide trench crossing to accommodate public travel.

#### B. TRENCH EXCAVATION

1. Trenches shall be of necessary width or the proper laying of the pipe but not more than 16" wider than pipe diameter, and the banks shall be as nearly vertical as practicable. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil

along its entire length. Except where rock is encountered, care shall be taken not to excavate below the depths indicated.

2. Where rock excavations are required, the rock shall be excavated to a minimum overdepth of four inches below the trench depths indicated on the Drawings or specified. Overdepths in the rock excavations and unauthorized overdepths shall be backfilled with loose granular material properly compacted.
3. Whenever wet or otherwise unstable soil that is incapable of properly supporting the pipe is encountered in the bottom of the trench, that soil shall be removed to the depth required and the trench backfilled to the proper grade with coarse sand, fine gravel or other material.
4. Keep trenches free from water while construction is in progress. Pipe or appurtenances shall not be laid in water. Pump the discharge from trench dewatering to drains or natural drainage channels.

C. GRADING TRENCH BOTTOM

1. Perform grading of trench bottoms by hand tools. Grade the bottom of trenches evenly to insure bearing for pipes. Cut holes for joints and joint-making.

D. DEPTH OF COVER

1. Minimum Depth of Cover for Storm and Sanitary Sewers:
  - a. As described in SPS 382.30 (11) (b). Provide insulation for sewers installed at less than minimum depth.
2. Minimum Depth of Cover for Water Service Piping:
  - a. The top of pipe shall be installed not less than six (6) feet below grade.

E. PIPE BEDDING

1. Crushed stone chips or bedding sand, compacted according to Class "B" bedding standards.

3.11 BACKFILLING OF TRENCHES

- A. Backfill trenches only after piping has been inspected, tested, and locations of pipe lines and appurtenances have been recorded.

- B. For a depth of 12 inches above the top of the pipe, backfill by hand with material specified for Compacted Backfill. Tamp this backfill thoroughly in layers not exceeding 6" in thickness, taking care not to disturb the pipe.

- C. For the remaining trench backfill and compact with material as specified in the following paragraphs. Jetting the backfill with water is not permitted.

D. NORMAL BEDDING

1. Where compacted backfill is not specified, the trenches shall be backfilled with the excavated materials approved for backfilling consisting of earth, loam, sandy clay, sand and gravel, soft shale or other approved materials, free from large clods of earth or stones over 2½" maximum dimension, deposited in 12" layers and compacted.
2. The surface shall be graded to a reasonable uniformity and the mounding over trenches left in a uniform and neat condition.

E. COMPACTED BACKFILL

1. Compacted backfill shall be used under the slab on grade, slabs within building structure, concrete paving and asphaltic concrete paving. The soils used in the fill shall be granular in nature and shall not contain roots, sod, rubbish or stones over

2½" maximum dimension. The A/E may reject on-site or borrowed materials which he considers not intended for use as fill.

F. COMPACTION DENSITY FOR BACKFILL

1. Fills shall be compacted to a dry density equal to at least 95 percent of the maximum density determined in accordance with the Proctor Test, ASTM D 698-66T or modified D1557-66T. The maximum density and optimum moisture content shall be determined by the A/E on the basis of laboratory test conducted on the materials used in the fill.

G. CONTROL TEST

1. Adequacy of compaction shall be determined on the basis of in place density determinations that are to be conducted while the fills are being placed. The results of these tests shall be the basis on which satisfactory completion of the work is judged. If the fills fail to meet the specified densities, the Contractor shall remove and recompact the soils until the specified densities are achieved. Contractor shall provide proof of test upon request.

H. EQUIPMENT

1. The choice of compaction shall be made by the Contractor, however, the equipment shall be adequate for achieving the specified densities. To achieve adequate compaction at locations inaccessible to roller type equipment, use of hand operated, power driven compaction equipment may be necessary.

END OF SECTION

## SECTION 22 05 25 - PLUMBING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DESCRIPTION

- A. Furnish and install fittings and specialties.

#### 1.3 SUBMITTALS

- A. Submit product data sheets in accordance with Division 1 and Section 22 01 00.
- B. Submit and pay fees to State of Wisconsin for backflow prevention device registration and testing. Submit State approval of reduced pressure zone backflow prevention device with product data sheets in accordance with Division 1 and Section 22 01 00.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. Refer to Plumbing Equipment Schedule for specific model numbers and sizing information regarding the plumbing fittings and specialties specified herein.

#### 2.02 BACKFLOW PREVENTION DEVICES

##### A. ACCEPTABLE MANUFACTURERS

- 1. Cash-Acme, Chicago, Cla-Val, Conbraco, Febco, Nidel, Watts or Wilkins.

##### B. VACUUM BREAKERS

- 1. For use in finished areas with concealed piping, brass construction, chromium plated, Chicago Faucet No. 892-G (1/2").
- 2. Hose thread inlet and outlet, non-removable hose connection, vacuum breaker for use on service sink faucets, Chicago Faucet No. E27, 3/4 inch.

#### 2.03 PRESSURE REGULATING VALVES (PRV)

- A. Pressure regulating valves shall be manufactured by Cash Acme, Wilkins, or Watts.
- B. Direct acting, spring regulating, bronze body, high temperature resistant diaphragm, ASSE 1003. Include strainer with stainless steel mesh screen and pressure gauges on inlet and outlet of PRV.
- C. Size strainer for flow rate in main with 10 psig drop off, not line size.

#### 2.04 HOSE BIBBS/WALL HYDRANTS

- A. Hose bibbs and wall hydrants shall be manufactured by Chicago Faucet, MIFAB, Woodford, or Zurn.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

#### A. VACUUM BREAKER/BACKFLOW PREVENTORS

1. Install per Plumbing Code.

#### B. REDUCED PRESSURE ZONE BACKFLOW PREVENTORS

1. Install in conformance with requirements of Wisconsin Plumbing Code, manufacturer's recommendations and as shown. After installation and initial testing, submit the proper paperwork to the Department of Safety and Professional Services.

#### C. PRESSURE REGULATING VALVES

1. Adjust PRV to regulate outlet water pressure to 70 psig.

#### D. HOSE BIBBS/WALL HYDRANTS

1. Install 24 inches above finished grade or floor.

END OF SECTION



## SECTION 22 07 00 - PLUMBING INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DESCRIPTION

- A. Furnish labor, equipment, accessories, materials and services required to install insulation, fittings and finishes for piping and related equipment.

#### 1.3 SUBMITTALS

- A. Submit product data sheets in accordance with Division 1 and Section 22 01 00.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Armstrong, Halstead, Johns-Manville, Knauf, or Owens-Corning.

#### 2.2 INSULATION TYPES

##### A. ACCEPTABLE MANUFACTURERS

- 1. Armstrong, Halstead, Johns-Manville, Knauf, or Owens-Corning.

##### B. GLASS FIBER

- 1. Manville Micro-Lok meeting ASTM C547; rigid molded, non-combustible, "K" Value: 0.23 at 75°F, maximum service temperature: 850°F, with vapor Retarder Jacket: AP-T Plus White Kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips or AP Jacket with outward clinch expanding staples or vapor barrier mastic as needed.

##### C. ELASTOMERIC FOAM

- 1. Halstead Insul-tube meeting ASTM C534; flexible, cellular elastomeric, molded or sheet, "K" Value: 0.255 at 75°F, and 0.26 at 90°F, maximum Service Temperature: 220°F, and minimum service temperature of minus 40°F, maximum Flame Spread: 25, maximum Smoke Developed of 50.
- 2. Connection:
  - a. Waterproof vapor retarder adhesive; Halstead Contact Adhesive.
- 3. UV-Protection:
  - a. Outdoor protective coating; Armstrong Protective Coating.
- 4. For use in walls only on water supply to fixtures.

#### 2.3 PIPING INSULATION

##### A. MINIMUM INSULATION THICKNESS

| <u>SYSTEMS</u>            | <u>PIPE SIZE</u>     |                      |                      |                     |
|---------------------------|----------------------|----------------------|----------------------|---------------------|
|                           | 1"<br><u>OR LESS</u> | 1 ¼" TO<br><u>2"</u> | 2 ½" TO<br><u>4"</u> | 5"<br><u>AND UP</u> |
| Domestic Cold Water       | ½"                   | ½"                   | 1"                   | 1"                  |
| Domestic Hot Water        | 1"                   | 1"                   | 1-½"                 | 1-½"                |
| Domestic Hot Water Return | 1"                   | 1"                   | 1-½"                 | ---                 |
| Non-Potable Cold Water    | ½"                   | ½"                   | 1"                   | ---                 |

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Application of insulation to piping equipment shall be done in accordance with the manufacturer's installation recommendations. Where thickness of insulation is not specified, use thickness recommended by manufacturer or required by applicable Codes.
- B. Insulation shall be applied in as warm an environment as possible, and in no instance below 25°F.
- C. No pipe shall be covered until after it has been installed, inspected, tested and approved.

### 3.2 PIPING INSTALLATION

- A. Pipe insulation shall be installed with joints butted firmly together. Valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to the adjoining insulation, or with insulating cement equal in thickness to the adjoining insulation, or with "Zeston" type, premolded PVC fittings installed in accordance with the manufacturer's instructions. Fittings are to be finished with 8 oz. glass mesh and mastic (use breather mastic on systems operating above 50°F except where Zeston PVC covers are used). Jackets on pipe insulation may be stapled using outward clinch staples spaced 3" apart at least ¼" in from the lap edge on systems operating at 60°F and above; below 60°F the laps are to be vapor sealed using self-sealing lap, lap-seal tape gun or adhesive (ex: Armstrong 520.) Insulation ends shall be tapered and sealed regardless of service.
- B. On insulated piping, use protection shield to cover bottom one-half of insulated pipe. Shield to be minimum of 12" long and 16 gauge galvanized steel. Provide half-round, 12" long, hanger block at the bottom half of the pipe in place of the fiberglass pipe insulation. The hanger blocks shall be molded cork or calcium silicate pipe insulation of the same thickness as the adjoining fiberglass pipe insulation. The insulation and jacket shall be continuous through the hanger location.
- C. Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal. Pipe hangers shall be sized large enough to be installed over the outer surfaces of the insulation.
- D. Elastomeric thermal insulation shall be applied in accordance with manufacturer's written instructions. Elastomeric foam shall only be used on fixture water supply piping in walls.

- E. Omit insulation for:
  - 1. Unions and flanges.
  - 2. Vents to atmosphere, discharges from relief valves and drain pipes.
- F. Provide finished edges at access doors and end.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 22 11 00 - FACILITY WATER DISTRIBUTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DESCRIPTION

- A. Provide a domestic water distribution system including hot and cold water supply piping, hot water return piping, valves, fittings, hardware, and specialties. Connect to plumbing fixtures, specialties, and equipment.
- B. Work under this section shall commence 5'-0" outside the building structure with a connection to the combination water supply lateral provided by the site utility contractor.

#### 1.3 SUBMITTALS

- A. Submit product data sheets in accordance with Division 1 and Section 22 01 00.

### PART 2 - PRODUCTS

#### 2.1 WATER DISTRIBUTION PIPE AND FITTINGS

##### A. UNDER GROUND

- 1. 2" and Smaller:
  - a. Seamless copper tube, type K, soft temper, ASTM B88, with wrought copper fittings. ANSI B16.22. Join using lead free flux and solder, ASTM B32, flux ASTM B813.
- 2. 3" and Larger:
  - a. Ductile iron pipe, mechanical or push on joint, thickness class 53 conforming to AWWA C-151 with standard thickness cement mortar lining AWWA C-104; ductile iron or gray iron mechanical joint cement mortar lined fittings, Class 250, AWWA C110; ductile iron restrained joint compact fittings, class 350, AWWA C-153; rubber gasket joints with non-toxic gasket lubricant, AWWA C-111. Joints shall have ASTM A506 steel clamps and straps for restraints with ASTM A307 steel bolts and ASTM A575 steel rods. Provide 8-mil tube or sheet polyethylene encasement of iron pipe and pipe fittings, AWWA C105.

##### B. ABOVE GROUND

- 1. Copper tube, Type L, hard temper, ASTM B88; with wrought copper fittings, ANSI B16.22. Join using lead free flux, ASTM B813, and solder, ASTM B32.
- 2. Wrought copper, ANSI B16.22 or cast bronze, ANSI B16.18 fittings, copper tube dimensioned grooved ends, joined with mechanical couplings, synthetic rubber gasket seal, Victaulic style 606.
- 3. Copper press fittings, ASTM B16.18 or ASTM B16.22, EPDM O-ring by Viega. Press fittings by Elkhart Products and Nibco will also be acceptable.

## 2.2 VALVES

### A. MANUFACTURER

1. Valves throughout the project shall be by one manufacturer, unless otherwise specified.
2. Standard valves are based on Nibco models. Valves shall be of standard dimensions, comparable to the number specified.
  - a. Equivalent style ball valves as manufactured by Apollo, Hammond, Milwaukee Valve, or Watts are acceptable.
  - b. Equivalent style butterfly valves as manufactured by Crane, DeZurik, Gustin-Bacon, Grinnell, Hammond, Jenkins, Milwaukee Valve, Victaulic, or Watts are acceptable.
  - c. Equivalent style gate valves as manufactured by Crane, Hammond, Jenkins, Lunkenheimer, Milwaukee Valve, Stockham, or Watts are acceptable.
  - d. Equivalent style check valves as manufactured by Apollo, Crane, Hammond, Milwaukee Valve, or Watts are acceptable.
3. Balancing valves are based on Bell & Gossett models. Equivalent style valves by Armstrong, Flowset, Nibco, Victaulic/TA Hydronics, or Taco are acceptable.

### B. SHUTOFF VALVES

1. Except as otherwise specified, shutoff valves 2-1/2" and smaller shall be ball valves and shutoff valves 3" and larger shall be butterfly valves, unless required otherwise by local Water Utility specifications.
2. Ball Valves:
  - a. Bronze, two piece full port ball valves with bronze body, solder or threaded ends, stainless steel ball, reinforced Teflon seats and seals, blowout proof stem design, rated at 600 PSI non-shock WOG, Nibco model T/S-585-70-66. Include handle extension for insulated piping, NIB-SEAL by Nibco.
  - b. Bronze, three piece full port ball valves with bronze body, solder or threaded ends, stainless steel ball, reinforced Teflon seats and seals, blowout proof stem design, rated at 600 PSI non-shock WOG, Nibco model T/S-595-66. Include handle extension for insulated piping, NIB-SEAL by Nibco.
3. Butterfly Valves:
  - a. Ductile iron butterfly valve, polymid coated, EPDM elastomer coated disc, extended neck, grooved ends, 300 psi WOG pressure rated, Nibco GD 4765. Include lever handle through 6-inch size..
  - b. Cast bronze butterfly valve, EPDM elastomer coated ductile iron disc, copper tube dimensioned grooved ends, 300 psi maximum pressure rated, Victaulic Series 608. Include lever handle through 6-inch size.
4. Gate Valves:
  - a. 2 1/2" and larger: Outside screw and yoke, 300 psi test, and 175 psi working pressure, cast iron body, bronze mounted, bolted bonnet, rising stem and solid wedge. UL listed and FM approved. Nibco F-607-O.

### C. CHECK VALVES

1. Swing Type
  - a. 3" and Smaller:
    - 1) Bronze body, Class 125, Y-pattern, swing type, check valve with solder ends, all bronze internal components and renewable seat and disc, Nibco model S-413-B.

2. Spring Loaded Type
  - a. 2" and smaller:
    - 1) Bronze body, ASTM B62, in-line lift type, spring, Buna-N disc, 250 psig WOG rating. Nibco 480

D. BALANCING VALVES

1. ½" thru 2":
  - a. Bronze or brass body balancing valve with sweat or threaded ends, calibrated brass orifice, integral adjustment knob with calibrated scale, memory stop indicator, drain tapping and differential pressure metering connections, Bell & Gossett "Circuit Setter" or Victaulic/TA Hydronics Series 786/787.

E. GAUGE VALVES

1. ¼" Size:
  - a. Bronze body, rising stem gauge/globe valve with renewable seat and disc and malleable iron hand-wheel, Nibco T-235. Valve shall be rated for 300 PSI non-shock WOG.

2.3 UNIONS AND FLANGES

A. UNIONS

1. Bronze, solder connection, Nibco figure 733.
2. Where grooved joint piping systems are utilized, grooved joint couplings shall serve as unions.

B. FLANGES

1. Cast copper alloy, class 125, MSS SP-106, Nibco figure 741.
2. Ductile iron housings, coated with copper colored alkyd enamel, class 125, Victaulic Style 641.

2.4 DIELECTRIC COUPLINGS

- A. Steel casing, zinc electroplated, with inert thermoplastic lining, various end types, Clearflow, style 47 by Victaulic.

1. Dielectric flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets and pressure rating of not less than 175 psig at 180 degrees Fahrenheit. Watts Regulator Company, Lochinvar, Wilkins, Epco Sales, Inc.

2.5 STRAINERS

- A. Acceptable manufacturers are Armstrong, Keckley, Metraflex, Mueller Steam, Nibco, or Watts.

- B. Y type, cast bronze body, ASTM B62, 20 mesh stainless steel screens, bolted or threaded screen retainer tapped for a blowoff valve, threaded or flanged body, 150 psi pressure rating.

- C. Y type, cast iron body, ASTM A126, 20 mesh stainless steel screens, bolted or threaded screen retainer tapped for a blowoff valve, threaded or flanged body, 150 psi pressure rating.

## 2.6 WATER HAMMER SUPPRESSORS

- A. Acceptable manufacturers are MIFAB, PPP, Sioux Chief, and Watts.
- B. Piston compressed air column type, with sealed air chamber.
- C. Water supply piping serving fixtures, appliances, equipment and devices with quick closing or solenoid- actuated valves shall be provided with water hammer arrestors. Also provide water hammer arrestors where indicated on the water supply piping as shown on the water supply isometrics. Devices shall be mechanical arrestors installed in accordance with PDI Standard WH201. Air chambers shall not be used.
- D. Shop drawings are required. Submit to A/E for approval prior to installation.
- E. Water hammer arrestors must be accessible for inspection and replacement. Provide access panel.

## PART 3 - EXECUTION

### 3.1 TRENCHING, BACKFILLING AND COMPACTING

- A. See Section 22 05 00.

### 3.2 WATER PIPING SYSTEM

- A. Piping shall be pitched to drain entire system; install drain valves at low points. Provide unions or grooved joint couplings at equipment and valves. Provide offsets and transition fittings. Avoid dips or depressions in pipe runs.
- B. No water piping shall be installed in exterior walls, unless adequately protected from freezing. Two inch insulation shall be installed on back and sides of chase, front shall be open to room heat, covered only by finished wall material.
- C. Install unions, grooved joint couplings, or flanges at equipment connections and to facilitate removal of equipment.
- D. Install dielectric couplings at connections between copper pipe and other metals. Use dielectric unions for connecting copper and steel piping.
- E. Provide backflow devices as dictated by Code on water connections to HVAC equipment and other equipment.
- F. Extend hot water piping from water heater and connect to fixtures and equipment.
- G. Hot water and cold water lines shall be kept at least 6 inches apart whenever possible.
- H. SOLDERED JOINTS
  - 1. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.



I.     **THREADED JOINTS**

1.     Use a thread lubricant or Teflon tape when making joints. Hard setting pipe thread cement or caulking will not be allowed.

J.     **GROOVED JOINTS**

1.     All grooved couplings, fittings and valves shall be of the same manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically inspect the product installation. Contractor shall remove and replace any improperly installed products.

K.     **PRESSED FITTINGS**

1.     Copper press fittings shall be made in accordance with manufacturer's instructions. Fittings shall leak under low pressure when the fitting has not been pressed. The tubing shall be inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints to be pressed using the tool approved by the fitting manufacturer.

L.     **HOT WATER RE-CIRCULATING SYSTEM**

1.     Install return system including check valves, balancing valves, and pumps. Pitch and grade lines to provide circulation throughout the entire system.
2.     Adjust each balancing valve and set position stop. Balance system to minimum flow in return piping branches needed to maintain even supply water temperature and to provide continuous circulation throughout building. Provide balancing report along with O&M manual submittals. Test and demonstrate upon request.

M.     **VALVE INSTALLATION**

1.     Install shutoff valves with stem vertical. Exception; the stem may be horizontal if a vertical installation does not allow access to the valve handle.
2.     Valves with screwed ends shall be installed using "Teflon" tape applied on male portion of piping fitting.
3.     Each individual fixture or piece of equipment shall have an independent shut-off valve adjacent to fixture in addition to the required branch shut-off. Where valves are installed in walls, an access panel shall be provided.

N.     **BRANCHES**

1.     Valve shut-off full size of branch for each branch take-off to supply stack or fixture group.

O.     **DRAINS**

1.     Provide valved drains at low points of systems. Piping shall be arranged to drain through valved drains.

P.     **FLUSHING MAINS AND BRANCH PIPING**

1.     Upon completion of the water distribution system, test valves to insure their full opening and flush out the system progressively by opening drain valves and

building outlets and permitting the flow to continue from each until the water runs clear.

Q. PIPE INSULATION

1. Provide pipe insulation for all domestic water piping per Section 22 07 00.

R. STERILIZATION OF WATER DISTRIBUTION SYSTEM

1. Immediately after the water distribution system has been flushed out until water at all taps is clear, it shall be sterilized in accordance with the requirements of the local Health Department/Water Utility. In the absence of local requirements, the following methods shall be used:
  - a. Introduce chlorine or a solution of calcium or sodium hypochlorite, filling the lines slowly and applying the sterilizing agent at a rate of 50 parts per million of chlorine, as determined by residual chlorine tests at the ends of the lines. Open and close valves and hydrants while the system is being chlorinated.
  - b. After the sterilizing agent has been applied for 24 hours, test for residual chlorine at the ends of the lines. If less than 5 PPM, repeat the sterilization process.
  - c. When tests show at least 5 PPM of residual chlorine, flush out the system until traces of the chemical used are removed.

S. SAMPLES

1. After disinfecting the water distribution system, take water samples to check for bacteria. Take 5 water samples from remote faucets, plus the main entrance. Send the samples to Wisconsin Department of Health Lab to sample for a safe water supply system.

3.3 TESTING

- A. Refer to Division 1, "Starting of Systems" and Section 22 01 00 – Operation and Maintenance of Plumbing.
- B. Hydro-statically pressure test water piping to 150 psig for 4 hours. No decrease in pressure is allowed. Provide pressure gauge with shutoff and a bleeder valve at the highest point of the system tested. Inspect joints in system under test. No leaks allowed.
- C. Systems with a combination water supply fire protection service shall have the service portion of the system tested per NFPA 24.
- D. Do not conceal pipe until satisfactorily tested.
- E. Testing with air will not be allowed.

END OF SECTION

## SECTION 22 13 00 - DRAIN AND VENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DESCRIPTION

- B. Interior sanitary drain and vent piping systems including branches, drains, cleanouts, stacks, fittings and hardware.
- C. Work under this section shall commence from 5 feet outside the building wall with a connection to the sanitary building sewer lateral.

#### 1.3 SUBMITTALS

- D. Submit product data sheets in accordance with Division 1 and Section 22 01 00.

### PART 2 - PRODUCTS

#### 2.1 BELOW GROUND PIPE AND FITTINGS

- A. PVC, Schedule 40, Type I, ASTM D-1785, and PVC drain-waste-vent fittings, ASTM D2665, with solvent weld joints, ASTM D2855, primer, ASTM F656, solvent cement, ASTM D2564. (Note: PVC materials shall not be installed where high temperature discharge is expected)

#### 2.2 ABOVE GROUND PIPE AND FITTINGS

- A. Cast iron, no-hub, service weight, ASTM A888, CISPI 301, with rubber gasket couplings, ASTM C564, and stainless steel clamp, CISPI 310. Piping and fittings shall be manufactured by AB&I, Charlotte, or Tyler, and shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.
- B. PVC, Schedule 40, Type I, ASTM D-1785, and PVC drain-waste-vent fittings, ASTM D2665, with solvent weld joints, ASTM D2855, primer, ASTM F656, solvent cement, ASTM D2564. (Note: PVC materials shall not be installed in spaces used as air plenums, or where high temperature discharge is expected)
- C. OPTIONAL MATERIALS FOR PIPING 2" AND SMALLER
  - 1. Copper tube, Type DWV, ASTM B-306, with cast copper drainage fittings (DWV), ANSI B16.23, or wrought copper drainage fittings (DWV), ANSI B16.29. Join using lead free flux, ASTM B813, and solder, ASTM B32.

#### 2.3 DRAINS AND CLEANOUTS

- A. Drains and cleanouts shall be manufactured by J.R. Smith, Josam, MIFAB, Sioux Chief, Wade, Watts, or Zurn. Refer to Plumbing Drain and Cleanout Schedule.

## PART 3 - EXECUTION

### 3.1 DRAIN AND VENT PIPING SYSTEM

- A. Connect drain and vent piping to each fixture and piece of equipment. Provide fittings and hardware to make required offsets and transitions.
- B. Changes in direction of drainage piping shall be made by the appropriate use of 45 degree wyes, long or short sweep 1/4 bends, 1/6, 1/8, 1/16 bends or combination.
- C. Fittings installed shall make for the least possibility of stoppage. Horizontal drainage piping less than 3 inches shall be pitched a minimum of 1/4 inch per foot of run. Pitch drainage piping 3" and larger a minimum of 1/8" per foot of run.
- D. When running drain piping below a footing and parallel to it, piping shall be at least one foot greater in distance away from footing than below its bottom. Where possible, run sewers at centerpoint between two parallel footings and maintain above-mentioned distances at a minimum. When running drain piping under a footing, disturb as little of the soil under footing as possible. Provide concrete fill under footings where excavations wider than 18" are required.
- E. Connect to drains, fixtures and equipment.

### 3.2 PIPE JOINTS

- A. Install cast iron pipe and fittings, hubless pattern, as recommended by CISPI standards 301, 310, and in their publication "Installation Suggestions for Cast Iron No-Hub Pipe and Fittings".
- B. Prepare PVC pipe ends as recommended by manufacturer. Use a P-70 type primer (for PVC) and a PVC solvent cement appropriate to the pipe size and temperature range.
- C. Soldered joints shall be as described in Section 22 11 00.

### 3.3 PLENUM CEILING SPACES

- A. PVC piping shall not be installed in spaces used as air plenums. Review HVAC drawings and specifications to determine locations of areas used as air plenums.

### 3.4 VENT FLASHING

- A. Vent pipes passing through roof shall be covered with sheet lead weighing not less than 4 pounds per square foot. Sheet lead shall be well flashed onto the roof, 12" around pipe. Vent pipes shall extend a minimum of 12" above roof.

### 3.5 CLEANOUTS

- B. Provide cleanouts as shown on plans and per Plumbing Code.

### 3.6 TRAPS

- A. Trap fixtures and equipment. Trap seals shall be standard depth, except when deep seals are required by Code. Traps shall be set true and level and located within the limits of the Code requirements. A trap shall not be used as a separator, interceptor or other type of device to retain solids. Traps above grade shall be provided with screw-type cleanout plugs.
- B. Traps shall be protected during construction and sealed to prevent foreign matter from entering. Provide adjustable expansion plug, plastic cap, or equivalent.

### 3.7 TESTING

- A. Refer to Testing paragraph of Section 22 01 00.
- B. Hydro-statically pressure test waste and vent piping to 10 feet of water column pressure for 2 hours. No leaks allowed. Provide mint test of entire system when required by local authorities.
- C. Hydro-statically pressure test pressure piping to 100 psi for 2 hours. No leaks allowed.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 22 30 00 - PLUMBING EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DESCRIPTION

- A. Provide plumbing equipment as listed in this section and as scheduled on the drawings.

#### 1.3 SUBMITTALS

- A. Submit product data sheets in accordance with Division 1 and Section 22 01 00.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. Refer to Plumbing Equipment Schedule for specific model numbers and sizing information of the plumbing equipment specified herein.

#### 2.2 WATER SOFTENERS

##### A. ACCEPTABLE MANUFACTURERS

- 1. Bruner, Culligan, Diamond, Hellenbrand, Marlo, North Star, or pre-approved equal.

##### B. MINERAL/RESIN TANK

- 1. Fiberglass reinforced tank, cation exchange resin, automatic regeneration, meter actuated, internal bypass, flow control backwash, 150 psi operation, N.S.F. approved, U.L. listed.

##### C. VALVE

- 1. Solid brass type, with hydraulically balanced piston valves, dual drive motors, backwash flow control, automatic bypass and sample clock.

##### D. BRINE/SALT STORAGE TANK

- 1. Polyethylene tank construction, float system to limit brine, with salt platform and separate well for brine valve. Include cover on tank assembly.

##### E. REGENERATION CONTROL

- 1. Delayed regeneration system set to regenerate on off hours. 120 volt, A.C. with 3-prong plug and cord. Set regeneration for early a.m. operation.

#### 2.3 WATER HEATERS

##### A. ELECTRIC STORAGE TYPE HEATERS

- 1. Acceptable manufacturers are A.O. Smith, Lochinvar, Rheem, Ruud, or State.
- 2. The units shall be electric storage type water heaters meeting ASHRAE 90.1B-1990 requirements. Heater tank shall be glass lined with a working pressure of

150 PSI and include foam insulation, magnesium anode rod and three year tank warranty for leakage. Unit shall have medium density immersion elements, adjustable immersion thermostat, magnetic contactors, control circuit transformer, integral fuse protection, manual reset high limit temperature device and be furnished with a factory provided temperature and pressure relief valve. Electrical and control components shall be factory prewired. The unit shall be UL listed.

## 2.4 HOT WATER CIRCULATING PUMPS

- A. Pump shall be manufactured by Armstrong, Bell & Gossett, Taco, or Thrush.
- B. Pump shall be 120 volt, single phase, 3450 RPM, in-line bronze pump, with brass impeller. Refer to Plumbing Equipment Schedule on drawings for model number and capacity.
- C. TIME CONTROL
  - 1. Time controls shall be manufactured by Paragon Electric Co. or equivalent. Provide a 120 VAC electronic programmable time controller for each circulating pump. Unit shall include seven day, 365 day per year programmable features and rechargeable battery backup; Paragon Electric Co. model number EC72, or equal.
- D. MOTOR STARTER
  - 1. Starters shall be manufactured by Allen-Bradley, Cutler-Hammer, G.E., or Square D. Provide a single phase manual motor starter switch for starting and controlling each pump, with internal overload protection, general purpose enclosure, neon pilot light and HAND-OFF-AUTO selector switch; Allen-Bradley Model 600-TAX142.

## 2.5 EXPANSION TANKS

- A. ACCEPTABLE MANUFACTURERS
  - 1. Amtrol, Bell and Gossett, or Wessels.
- B. Vertical steel precharged hydro-pneumatic expansion tank, 125 psi ASME labeled construction, including a replaceable flexible butyl rubber bladder, system connection fitting, Schrader type air charge fitting, steel base ring stand, factory prime and enamel painted exterior finish, ASME relief valve. Materials exposed to water to be NSF or FDA approved for potable water service.

## PART 3 - EXECUTION

### 3.1 WATER SOFTENERS

- A. Provide full size valved bypass and valved inlet/outlet piping. Pipe backwash to nearby hub drain.
- B. Install softener per manufacturer's recommendation.
- C. Provide 1000 lb. of pelletized salt for initial start-up and operation.



### 3.2 WATER HEATERS AND CIRCULATING PUMPS

- A. Provide piping, unions, valves, thermometers, relief valves, and hardware.
- B. Locate water heaters with controls, relief valves, and access holes accessible for service and replacement without moving heaters. Install relief valve and extend relief piping individually and full size to the nearest floor drain.
- C. Install the domestic water heater(s) and circulator(s) in accordance with the Manufacturer's instructions and recommendations.
- D. Power wiring shall be provided by the EC.
- E. Mount each domestic water heater and storage tank on a 3½" high concrete pad.
- F. The manufacturer shall provide a written service warranty which shall provide factory service for a period of one year following the acceptance of the installation. The one-year service warranty shall be submitted at the time of the certified shop drawings submittal. The one-year service warranty by the manufacturer shall provide free parts and labor to correct malfunctions of the boiler-burner unit during the warranty period.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 22 40 00 - PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 DESCRIPTION

- A. Furnish and install plumbing fixtures with traps, drains, stops, faucets, flush valves, carriers and hardware.

#### 1.3 SUBMITTALS

- A. Submit product data sheets in accordance with Division 1 and Section 22 01 00.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. Fixtures must conform to general requirements given below and to specified requirements for each type.
- B. Vitreous china fixtures shall conform to ANSI A112.19.2M.
- C. Stainless steel fixtures shall conform to ANSI A112.19.3.
- D. Fixtures shall be installed so that parts are accessible for repairs when fixtures are in place. Manufacturer's trademark or name shall be visible on fixtures.
- E. Faucets, traps, exposed fittings and trim shall be polished chrome plated unless otherwise specified. Provide polished chrome plated nipples at lavatories.
- F. Exposed piping penetrating walls, floors or ceilings shall have chrome plated escutcheons, or flanges of depth to seal the opening.
- G. Fixture stops shall be heavy duty commercial grade, slow compression angle valves with 1/2" inlet and 3/8" or 1/2" chrome plated flexible riser.
- H. Traps shall be semi-cast 17-gauge brass, chrome plated, with cleanout and escutcheon. Lavatory traps shall be 1-1/4" minimum. Sink traps shall be 1-1/2" minimum.

#### 2.2 MANUFACTURERS

- A. Vitreous china iron fixtures shall be manufactured by American-Standard, Kohler, Toto, or Zurn. Fixture color shall be white unless specified otherwise.
- B. Flush valves shall be manufactured by Delaney, Sloan ("Royal" series), or Zurn ("Aquavantage" series).

- C. Solid plastic toilet seats shall be manufactured by Bemis, Benneke, Centoco, Church, Olsonite, Kohler, or Zurn. Seat color shall match fixture unless specified otherwise.
- D. Carriers for wall-mounted fixtures shall be manufactured by J.R. Smith, Josam, MIFAB, Wade, Watts, or Zurn.
- E. Cast terrazzo, molded stone, and stainless steel wash fountains shall be manufactured by Acorn, Bradley, Intersan, or Willoughby.
- F. Drinking fountains and electric water coolers shall be manufactured by Acorn Aqua, Elkay, Filtrine, Halsey Taylor, Haws, Oasis, or Sunroc.
- G. Cast terrazzo and molded stone products shall be manufactured by Crane/Fiat, Mustee, or Stern-Williams.
- H. Manual faucets shall be manufactured by American Standard, Chicago Faucet, Kohler, Moen Commercial, Speakman, Symmons, T&S Brass, or Zurn.
- I. Electronic sensor operated faucets shall be manufactured by Bradley, Chicago Faucet, Kohler, Moen Commercial, Sloan, Speakman, Toto, or Zurn.
- J. Emergency eyewash and shower equipment shall be manufactured by Bradley, Chicago Faucet, Encon, Guardian, Haws, or Speakman.
- K. Emergency equipment mixing valves shall be manufactured by Bradley, Haws, Lawler, Leonard, or Powers.
- L. Stops and supplies shall be manufactured by Chicago Faucet, EBC, Kohler, McGuire, T&S Brass, or Zurn. Only heavy duty type will be acceptable.
- M. Lavatory drains shall be offset type, 1-1/4" size, with flat grid strainer, manufactured by Dearborn, EBC, Keeney, Kohler, McGuire, Proflo, or Zurn.
- N. Traps shall be semi-cast 17 gauge brass, chrome plated, with cleanout and escutcheon as manufactured by Dearborn, EBC, Keeney, Kohler, McGuire, Proflo, or Zurn.
- O. Supply, drain and trap insulating kits shall be manufactured by Brocar, EBC, McGuire, Plumberex, Truebro, or Zurn.
- P. Special traps and solids interceptors shall be manufactured by J.R. Smith, Josam, Wade, Watts, or Zurn.
- Q. See Plumbing Fixture Schedule on drawings for type, manufacturer, and model for fixtures.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Plumbing fixtures shall be installed as recommended by their respective manufacturer.
- B. Individual supplies to fixtures shall be provided with support to prevent movement.

- C. Seal joints between countertop, wall, floor and fixtures with G.E. Silicone caulk; white, clear or color to match fixture with colored caulk by fixture manufacturer.
- D. After installation, fixtures shall be protected to prevent scratching or other damage during construction.
- E. Prior to acceptance, fixtures shall be cleaned with compounds recommended by the respective manufacturer.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. 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.
- B. All Division 23 work as specified herein shall be provided by the HVAC Contractor unless otherwise specified on the Bid Form.

#### 1.2 RELATED WORK

- A. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
- B. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
- C. Section 23 33 00 – Air Duct Accessories

#### 1.3 REFERENCE

- A. Provisions of Division 01 govern work under this Section.
- B. This Section of Work applies to all work specified under Division 23.

#### 1.4 REFERENCE STANDARDS

- A. Abbreviations of standards organizations referenced in other sections are as follows:
  - 1. AABC Associated Air Balance Council
  - 2. ADC Air Diffusion Council
  - 3. AGA American Gas Association
  - 4. AMCA Air Movement and Control Association
  - 5. ANSI American National Standards Institute
  - 6. ARI Air-Conditioning and Refrigeration Institute
  - 7. ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
  - 8. ASME American Society of Mechanical Engineers
  - 9. ASTM American Society for Testing and Materials
  - 10. CGA Compressed Gas Association
  - 11. EPA Environmental Protection Agency
  - 12. GAMA Gas Appliance Manufacturers Association
  - 13. IEEE Institute of Electrical and Electronics Engineers
  - 14. ISA Instrument Society of America
  - 15. MCA Mechanical Contractors Association
  - 16. MICA Midwest Insulation Contractors Association
  - 17. MSSManufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
  - 18. NBS National Bureau of Standards
  - 19. NEBB National Environmental Balancing Bureau
  - 20. NEC National Electric Code
  - 21. NEMA National Electrical Manufacturers Association

- 22. NFPA National Fire Protection Association
- 23. SMACNA Sheet Metal and Air Conditioning Contractors' National Association. Inc.
- 24. UL Underwriters' Laboratories Inc.

#### 1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.
- B. The Contractor shall review his own work for compliance with the construction documents. Prior to punch list activity by A/E, the contractor shall provide documentation to the A/E that a review has taken place and shall issue a letter indicating that the work has been performed in compliance with the construction documents. In the event that the contractor does not satisfactorily review his own work and results in additional site visits by the A/E, the contractor shall reimburse the A/E for the additional time required to close out the project.

#### 1.6 QUALIFICATIONS OF BIDDERS

- A. All bidders must meet or exceed the following minimum requirements:
  - 1. Have been in business for a minimum of 3 years.
  - 2. Can be bonded for the proposed project if requested.
  - 3. Has access to necessary equipment and has organizational capacity and technical competence necessary to do the work properly and expeditiously,
  - 4. Provides a sworn financial statement upon request, which demonstrates that the bidder has adequate financial resources to complete the work being bid, as well as the other work the bidder has under contract.

#### 1.7 ABBREVIATIONS

- A. A/E Architect/Engineer
- B. GC General Contractor
- C. FPC Fire Protection Contractor
- D. PC Plumbing Contractor
- E. HC Heating Contractor
- F. EC Electrical Contractor
- G. TCC Temperature Contractor
- H. DDC Direct Digital Controls
- I. BAS Building Automation System
- J. TCS Temperature Control System

#### 1.8 DEFINITIONS

- A. Furnish



1. Supply and deliver to the project site ready for unpacking, assembly and installation
  - B. Install
    1. Operations at the site including unpacking, assembling, erecting, placing, anchoring, applying, finishing, cleaning, and connecting all related devices required for a product that is fully functional for its intended use after its installation.
  - C. Provide
    1. Furnish and install product as required to be fully functional for its intended use.
- 1.9 DRAWINGS
- A. The drawings show the general arrangement of piping, equipment and appurtenances and shall be followed as closely as actual building construction and work of other trades permits. Work shall conform to requirements shown on the drawings. Architectural and structural drawings shall take precedence. Because of the scale of the drawings, it is not possible to indicate all offsets, fittings and accessories that may be required. Investigate structural and finish conditions affecting work and arrange work accordingly, providing offsets, fittings and accessories as may be required to meet as constructed conditions.
  - B. HVAC equipment and systems, including piping and ductwork shall be installed as high as possible unless otherwise noted on drawings. Equipment and systems shall also be installed to maintain required operation and maintenance clearances.
- 1.10 CAD DRAWINGS
- A. Drawings in an electronic format can be made available to the successful HVAC contractor at a non-refundable cost as specified under Division 01 of the specifications. If no cost is specified in Division 01, the default cost shall be \$75 per drawing. The drawings provided may or may not be updated to reflect all addenda items. The use of the drawings is limited to this project and may not be forwarded to any other party, or used for any other purpose. Use of the files will be at the contractor's sole risk and without liability or legal exposure to Arnold & O'Sheridan, Inc or its employees. Architectural drawings or any other drawings not produced by Arnold & O'Sheridan will not be provided.
- 1.11 CODES AND STANDARDS
- A. All materials and workmanship shall comply with applicable codes, specifications, local ordinances, industry standards and utility company regulations. In case of differences between building codes, specifications, state laws, local ordinances, industry standards and utility company regulations and contract documents, the most stringent shall govern. Promptly notify A/E in writing of differences.
  - B. Non-compliance
    1. If the Contractor installs materials or performs any work that does not comply with above requirements, he shall correct the work and shall bear all costs arising from correcting deficiencies.

#### 1.12 PROTECTION OF FINISHED SURFACES

- A. Refer to Division 01 of the Project Manual.
- B. Furnish one can of touch-up paint for each different color factory finish which is to be the finished surface of the product. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

#### 1.13 OWNER FURNISHED EQUIPMENT

- A. The plans indicate equipment to be furnished or installed by the Owner. When providing utility connections, supply/exhaust connections to exhaust hoods or exhaust hoods themselves, coordinate the exact location and requirements with the Owner.

#### 1.14 SUBMITTALS

- A. Refer to Division 01 and the General Conditions of the Contract.
- B. Shop drawings are to be reviewed by the lead contractor and the HVAC contractor before submission to the A/E. Submittals shall be stamped by the contractor and clearly indicate all corrections made by the contractor during their review process. Submittals not reviewed and stamped by the contractor will be automatically rejected.
- C. Submit for equipment and systems as specified in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and number, as identified in the contract documents. Include the plan designation mark (i.e. "AHU-1") on the submittals. Include dimensions, capacities, ratings, and installation instructions.
- D. Before submitting electrically powered equipment, verify that the electrical power and control requirements for the equipment are in agreement with the motor schedule on the HVAC and electrical drawings. Include a statement on the shop drawing transmittal to the Architect/Engineer if the equipment submitted and the motor schedules are not in agreement, indicating any discrepancies. See related comments in Section 23 05 13, Part 1 under Electrical Coordination.
- E. Include wiring diagrams of electrically powered equipment.
- F. Submit the quantity of shop drawings as specified under the Division 01 Specification Section titled "Submittals."
- G. Submittals shall be legible, clear and complete. Shop drawings submitted that are incomplete, illegible or are not specific to the project will be returned as "not reviewed". In addition, equipment installed without having approved shop drawings will be considered defective and shall be removed and replaced with approved equipment at no expense to the project.

#### 1.15 SPECIFIED MATERIALS AND EQUIPMENT

- A. The design is based on the equipment specified by the manufacturer and model number as specified on the plan schedules. Where certain items are specified by manufacturer or trade name, Contractor's bid shall be based on use of the named item. Where one make is described and other makes are listed, comparable models of other named

equipment may also be used, provided that they meet all requirements of the specifications.

- B. When equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those on the plan schedules, the Contractor shall be responsible for costs involved in integrating the equipment or accessories into the system. The Contractor shall also be responsible for obtaining the original design performance from the system into which these items are placed, regardless of whether the manufacturer/model is a specified equivalent or a substitute. This may include changes found necessary during the testing, adjusting, and balancing phase of the project.
- C. If the Contractor wishes to use items other than those named in specifications in his base bid, request for approval of substitution must be made in writing to A/E at least 14 days prior to opening of bids. Including complete technical and descriptive data with the request. If approved, an addendum will be issued notifying all planholders of the approval.

#### 1.16 EQUIPMENT INSTALLATION

- A. The drawings show the general arrangement and location of equipment and appurtenances. It is the Contractor's responsibility to install equipment in a location and manner that allows for proper service and maintenance access to equipment. Work shall generally conform to requirements shown on the drawings. However, the location of equipment may require field adjustments to obtain the required service space. DO NOT SCALE OFF PLANS to determine proper location of equipment. Also, because of the scale of the drawings, it is not possible to indicate the exact routing of ductwork and piping, and offsets, fittings and accessories that may be required to provide proper service access to equipment. The Contractor shall route and install ductwork and piping to provide required service access to equipment.
- B. If during the construction phase of the project the contractor feels that inadequate space exists, or that equipment locations must be substantially modified to provide the proper service and maintenance access, prior to installing the equipment the contractor shall notify the engineer in writing, outlining the general concerns and the proposed modifications. Equipment installed without providing the manufacturer's required maintenance and service clearance shall be considered defective. The Contractor shall remove and relocate piping, ductwork and equipment, to provide the required service clearances at the Contractor's expense.

#### 1.17 OFF SITE STORAGE

- A. Refer to Division 01 of the Project Manual.

#### 1.18 CERTIFICATES AND INSPECTIONS

- A. Refer to the General Conditions of the Contract, Article 13.
- B. Obtain and pay for required Federal, State and local installation inspections, certificates and permits required, except those provided by the Architect/Engineer in accordance with State and local Codes. Deliver originals of these certificates to the Architect or Construction Manager.

#### 1.19 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Refer to Division 01 of the Project Manual.
- B. Provide HVAC systems and equipment operation and maintenance manuals in accordance with the requirements of the project specification.
- C. Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the data indicated in the General Requirements, include the following information:
  - 1. Copies of all approved shop drawings.
  - 2. Manufacturer's instructions for installation, operation, and maintenance.
  - 3. Manufacturer's wiring diagrams for electrically powered equipment.
  - 4. Records of tests performed to indicate compliance with system requirements (system start-up reports).
  - 5. Temperature control record drawings and control sequences.
  - 6. Parts lists for manufactured equipment.
  - 7. Valve schedules.
  - 8. Lubrication instructions, including list/frequency of lubrication done during construction.
  - 9. Warranties.
  - 10. Testing, adjusting and balancing data.

#### 1.20 TRAINING OF OWNER PERSONNEL

- A. Instruct Owner personnel in the proper operation and maintenance of systems and equipment provided as part of this project, using the Operating and Maintenance manuals during this instruction. Demonstrate startup and shutdown procedures for equipment. Training shall be during normal working hours.

#### 1.21 RECORD DRAWINGS

- A. Refer to Division 01 of the Project Manual.
- B. Maintain record drawings on a daily basis to be turned over at the completion of the project.
- C. At the completion of the project the Contractor shall provide electronic copies of the record drawings in AutoCad Version 13 to the A/E for review. The record documents shall include all Addendums, RFI's, CB's, FO's, Coordination Drawings, etc.
- D. Maintain temperature control record drawings on originals prepared by the installing contractor/subcontractor. Include copies of these record drawings with the Operating and Maintenance manuals.

#### 1.22 PROJECT CLOSEOUT

- A. Refer to Division 01 of the Project Manual.
- B. The Contractor shall complete and provide items and materials, training and start-up associated with project closeout as specified under Division 1 of the Project Manual. In addition to these items, the Contractor shall provide the following items prior to acceptance of the installation:

1. Final air system balancing, completed in accordance with the requirements of Section 23 05 93 and code, including the submission of testing, adjusting and balancing reports. Reports shall indicate the amount of total supply air, return air and outside ventilation air being provided to the spaces and to the air handling system(s).
2. Submission of Operating and Maintenance instructions in accordance with the requirements of Division 01, of this Section and code. Operation and maintenance manuals shall include a copy of the completed testing, adjusting and balancing report for the Owner's records.
3. Submission of start-up report for the temperature control system, signed by the technician in responsible charge of the control system, indicating that the system has been adjusted, calibrated and put into operation in accordance with the requirements of the specification and code.

## PART 2 - PRODUCTS

### 2.1 ACCESS PANELS

- A. Manufacturers:
  1. Milcor
- B. Provide access panels at locations requiring access to mechanical equipment. These locations include, but are not limited to areas above drywall ceilings, shaft enclosures and other furred-in spaces concealing valves, ducts or other equipment. Provide UL listed fire rated access panels when penetrating fire rated chase or shaft areas.
- C. Access panels shall be of size required to provide adequate access to equipment. Minimum size shall be 12"x12" for hand access and 24"x24" for body access.
- D. Panels shall be Milcor brand, or equivalent.
- E. Panels shall include concealed hinges, cam type locking devices, and have a frame/border type necessary for the particular wall or ceiling construction in which they are installed. Access panels shall be flush mounted, recessed frame type units. Access panels shall be prime coated steel, able to accept for field painting for general applications and stainless steel for use in toilet rooms, shower rooms and similar wet areas.
- F. Refer to architectural room finish schedule for wall and ceiling surfaces and finishes.
- G. For non-security applications, panel construction shall utilize a 16 gauge frame with not less than a 18 gauge hinged door panel. Door locks shall be screwdriver operated for panels in general location applications and shall be key locked for public area applications.

### 2.2 PIPE PENETRATIONS

- A. FIRE, SMOKE AND FIRE/SMOKE RATED SURFACES
  1. 3M CP 25N/S or CP 25S/L caulk, 3M FS 195 wrap/strip with restricting collar, 3M CS 195 composite sheet, Pipe Shields Inc. Series F fire barrier kits, Proset Systems fire rated floor and wall penetrations, Insta-Foam Products Insta-Fire Seal Firestop Foam or Dow Corning Fire Stop System.

2. UL listed or tested by an independent testing laboratory, approved by the State and Local Code jurisdictions. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Sleeves in concrete to be schedule 40 steel pipe with integral water stop unless the fire stop material used includes a sleeve that is an integral part of the rated assembly.

**B. NON-RATED SURFACES**

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor/ceiling plates for covering openings in occupied spaces.
2. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the un-insulated pipe and the cored opening or a water-stop type wall sleeve.
3. At interior partitions where pipe penetrations are sealed, use Tremco Dymonic, Sika Corp. Sikaflex 1a, Sonneborn Sonolastic NPI, or Mameco Vulken 116 urethane caulk to effect the seal. Use galvanized sheet metal sleeves in hollow wall penetrations.

**2.3 DUCT PENETRATIONS**

**A. FIRE, SMOKE AND FIRE/SMOKE RATED SURFACES**

1. 3M CP 25N/S or CP 25S/L caulk, 3M FS 195 wrap/strip with restricting collar, Insta-Foam Products Insta-Fire Seal Firestop Foam or Dow Corning Fire Stop System.
2. UL listed or tested by an independent testing laboratory, approved by the State and Local Code jurisdictions. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Sleeves in concrete to be minimum 16 gauge galvanized steel sleeves.

**B. NON-RATED SURFACES**

1. Fiberglass insulation fill at voids with galvanized steel sheet metal bank-off on both side of duct penetration thru walls. Caulking for sealing and sound proofing shall be fire resistant.

**2.4 IDENTIFICATION**

**A. STENCILS**

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

**B. ENGRAVED NAME PLATES**

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

**C. VALVE TAGS**

1. Round brass tags with ½ inch numbers, ¼ inch system identification abbreviation, 1¼ inch minimum diameter, with brass jack chains or brass "S" hooks around the valve stem, available from EMED Co., Seton Name Plate Company, or W. H. Brady.

D. PIPE MARKERS

1. At least ¾" high legend for piping under 3" diameter and at least 2" high legend for piping 3" diameter and larger. Include flow arrows. Manufacturers: W.H. Brady Co., EMED Co. or Seton Name Plate Company.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL

- A. Install lines passing under foundations with minimum of 1½ inch clearance to concrete and insure there is no disturbance of bearing soil.
- B. Before burying piping, mark up record drawings and dimensionally locate piping. Deliver information to A/E Field Representative.
- C. Unless otherwise specifically indicated on the plans, trenches for utilities shall be of a depth that provides the following minimum depths of cover from existing grade or from indicated finish grade, whichever is lower:
  1. Gas lines: 2 foot minimum cover
- D. Existing utility lines to be retained that are shown on the Drawings or the locations of which are made known to the Contractor prior to excavation, as well as utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling and if damaged, shall be repaired by the Contractor at his expense.
- E. Perform excavation and backfill work to accomplish indicated mechanical systems installation in accordance with Division 2.
- F. Trench Excavating
  1. Trenches shall be of necessary width or proper laying of the pipe but not more than 16" wider than pipe diameter at base and banks shall be provided per OSHA regulations. In particular, comply with the Department of Labor (OSHA) 29 CFR, Part 1926 Occupational Safety and Health Standards. Specific mention of this section however, shall in no way imply, suggest or infer that compliance with other sections or regulations is not required. Bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil at points along its entire length. Except where rock is encountered, care shall be taken not to excavate below the depths indicated.
  2. Where rock excavations are required, rock shall be excavated to a minimum overdepth of 4" below trench depths indicated on drawings or specified. Overdepths in rock excavations shall be backfilled with loose granular material properly compacted.
  3. Whenever wet or otherwise unstable soil that is incapable of properly supporting the pipe as determined by Soils Engineer is encountered in the bottom of the trench, soil shall be removed to depth required and trench backfilled to proper grade with coarse sand, fine gravel or other material as specified.
  4. Keep trenches free from water while construction is in progress. Pipe or appurtenances shall not be laid in water. Pump or bail water from bell holes to permit proper jointing of pipes. Pipe the discharge from trench dewatering to drains or natural drainage channels.

- G. Grading Trench Bottom
1. Shape bottom of trench for Class C bedding except as otherwise noted. Perform grading of trench bottoms by hand tools. Grade bottom of trenches evenly to insure bearing for pipes. Cut holes for joints and joint making.
- H. Excavations For Appurtenances
1. Excavations for manholes and similar structures shall leave at least 12" in the clear between their outer surfaces and the embankment or sheeting and shoring which may be used to hold and protect banks. Overdepth excavation below appurtenances that has not been requested by the A/E shall be considered as unauthorized and shall be backfilled with sand, gravel or concrete at the expense of the Contractor.
- I. Normal Backfill
1. Where compacted backfill is not specified the trenches shall be carefully backfilled with the excavated materials acceptable for backfilling consisting of earth, loam, sandy clay, sand and gravel, soft shale or other acceptable materials, free from large clods of earth or stones over 2½" maximum dimension, deposited in 12" layers and compacted.
  2. The surface shall be graded to a reasonable uniformity and the mounding over trenches left in a uniform and neat condition.
- J. Compacted Backfill
1. Compacted backfill shall be used under the slab on grade, slabs within building structure, concrete paving and asphaltic concrete paving. The soils used in the fill shall be granular in nature and shall not contain roots, sod, rubbish or stones over 2½" maximum dimension. The A/E may reject any materials considered unsuitable for the intended use.
- K. Compaction Density For Backfill
1. All fills shall be compacted to a dry density equal to at least 95% of the maximum density determined in accordance with the Procter Test, ASTM D698-66T or modified D1557-66T. The maximum density and optimum moisture content shall be determined by the A/E on the basis of laboratory test conducted on the materials used in the fill.
- L. Control Test
1. The field density tests for determining the compaction of the fill in place shall be performed by a qualified Geotechnical Engineer in accordance with standard recognized procedures for making required tests. The Contractor shall arrange and pay for tests and cooperate with the Geotechnical Engineer in obtaining soil samples for field and lab testing. A minimum of one test per 50 lineal feet for each 2' lift. Contractor shall pay for all density tests and submit reports.
  2. Adequacy of compaction shall be determined on the basis of in-place density determinations that are to be conducted while fills are being placed. Results of these tests shall be the basis on which satisfactory completion of the work is judged. If fills fail to meet specified densities, Contractor shall remove and recompact the soils until the specified densities are achieved.



### 3.2 CONCRETE WORK

- A. Provide to General Contractor layout drawings, anchor bolts, metal shapes, and templates required to be cast into concrete or used to form concrete for support of mechanical equipment.

### 3.3 CUTTING AND PATCHING

- A. Refer to Division 01 requirements.
- B. This Contractor shall be responsible for cutting and patching of the existing general construction to accommodate installation of the new HVAC system(s) unless otherwise noted.
- C. Patching includes repairing the openings remaining from the removal or relocation of existing system components and painting the surface to match existing. Painting means covering the entire wall where patching is to be done unless indicated to be done by other trades.
- D. Required cutting and patching shall be performed by personnel skilled in cutting and patching work.
- E. Do not pierce, modify or affect beams or columns without permission of the Architect/Engineer. If piping is required to pass through walls or floors where no sleeve has been provided, use a core drill to avoid unnecessary damage and structural weakening.

### 3.4 PAINTING

- A. Refer to Division 9 requirements.
- B. Exposed steel support structures (metal surfaces located both inside and outside the building) shall be painted after installation with one coat of a compatible metal primer coat and two coats of a finish coat of paint for the application. Color shall be gray unless otherwise specified.
- C. Exposed piping (uninsulated piping located outside the building, exposed to the weather) and exposed piping inside the building) shall be painted after installation with one coat of a compatible metal primer coat and two coats of a finish coat of paint for the application.
- D. Exposed piping (uninsulated piping located inside the building) shall be painted after installation with one coat of a compatible metal primer coat and two coats of a finish coat of paint for the application.
- E. Paint piping in accordance with the following color schemes:

|                |              |
|----------------|--------------|
| <u>Service</u> | <u>Color</u> |
| Natural gas    | Yellow       |
- F. Piping systems shall be clearly identified after painting with pipe markings as specified under the paragraph titled identification under this section.

### 3.5 BUILDING ACCESS

- A. Arrange for the necessary openings in the building to allow for admittance or removal of equipment and materials. When building access was not previously arranged and must be provided by this contractor, restore opening to its original condition after the apparatus has been brought into the building. Coordinate with the Architect/Engineer.

### 3.6 EQUIPMENT ACCESS

- A. Install piping, conduit, ductwork, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for equipment and specialties. Where access is required in plaster walls or ceilings, furnish and install access doors required. Coordinate for installation of access doors utilizing the General Contractor and other appropriate on-site Subcontractor for access door installation.
- B. Accessible ceilings, (i.e. lay-in ceilings) do not require access panels. Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings.

### 3.7 COORDINATION OF WORK

- A. Verify that devices are compatible for the surfaces on which they are used. This includes, but is not limited to, diffusers, registers, grilles, and recessed or semi-recessed heating and cooling terminal units installed in/on architectural surfaces.
- B. Coordinate work with other contractors prior to installation. Installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
- C. Verify system completion prior to start of the testing and balancing. Work to be completed prior to testing and balancing shall include, but not be limited to the following: flushing, pressure testing, chemical treatment, filling of hydronic systems, proper pressurization and air venting of hydronic systems, cleaning and replacement of filters, cleaning of strainers, duct and pipe system cleaning, adjusting and calibration of controls, controls cycled through their sequences. Install dampers, shutoff and balancing valves, flow measuring devices, gauges, temperature controls for fully functional and balanced systems. Demonstrate the starting, interlocking and control features of each system so the test and balance agency can perform its work. Provide the appropriate sections of work with required wall, roof and floor opening locations and dimensions. If this Contractor neglects to coordinate this information, openings shall then be the responsibility of this Contractor.

### 3.8 PIPE PENETRATIONS

- A. GENERAL
  - 1. Coordinate the location of building surface penetrations with the appropriate contractors. Furnish sleeves, inserts, and other devices that are to be built into the structure to the contractor performing that work. Prepare shop drawings for approval for penetrations of structural elements, including floor slabs, shear walls, and bearing walls. Do not allow penetrations to be made until shop drawings are approved.

B. FIRE RATED SURFACES

1. Install products in accordance with the manufacturer's instructions where a pipe penetrates a fire rated surface. When pipe is insulated, use a product which maintains the integrity of the insulation and vapor barrier. Where a sleeve must be installed in an existing floor, grout area around sleeve to restore the floor integrity. In a wet area floor penetration, top surface of penetration to be 2 inches above the adjacent floor with the additional height obtained by means of a concrete pad poured integral with the floor; wet areas for this paragraph are rooms or spaces containing air handling unit coils, convertors, pumps, chillers, boilers, and similar equipment.

3.9 DUCT PENETRATIONS

A. GENERAL

1. Coordinate the location of building surface penetrations with the appropriate contractors. Furnish sleeves, inserts, and other devices that are to be built into the structure to the contractor performing that work. Prepare shop drawings for approval for penetrations of structural elements, including floor slabs, shear walls, and bearing walls. Do not allow penetrations to be made until shop drawings are approved.
2. In a wet area, the top surface of penetration to be 2 inches above the adjacent floor. The additional height shall be obtained by means of a concrete pad or pipe sleeve poured integral with the floor. Wet areas are mechanical equipment rooms or spaces containing air handling unit coils, convertors, pumps, chillers, boilers, and similar equipment.

B. FIRE RATED SURFACES

1. Install products in accordance with the manufacturer's instructions where a duct penetrates a fire rated surface. When duct work is insulated, use a product which maintains the integrity of the insulation and vapor barrier. Where a sleeve must be installed in an existing floor, grout area around sleeve to restore the floor integrity. In a wet area floor penetration, top surface of penetration to be 2 inches above the adjacent floor with the additional height obtained by means of a concrete pad poured integral with the floor; wet areas for this paragraph are rooms or spaces containing air handling unit coils, convertors, pumps, chillers, boilers, and similar equipment.

3.10 CLEANING

- A. Contractor shall at all times keep premises free of waste or surplus materials, rubbish and debris which is caused by his employees or resulting from his work.
- B. After equipment and fixtures have been installed, Contractor shall remove all stickers, stains, labels and temporary covers.
- C. All foreign matter shall be removed from pipes, tanks, pumps, fans, motors, devices, switches, fixtures, panels and ductwork before acceptance of systems.
- D. Contractor shall leave his portion of the work in a safe and clean condition ready for operation.
- E. In case of dispute, Owner may remove rubbish, excess materials or do cleaning, and charge the cost to Contractor.

### 3.11 IDENTIFICATION

- A. Identify equipment in mechanical equipment rooms and above ceilings, including terminal heating devices by stenciling equipment number and service with one coat of black enamel against a light background or white enamel against a dark background. Use a primer where necessary for proper paint adhesion. Do not label equipment in occupied spaces (for example cabinet heaters and ceiling fans).
- B. Identification plates on equipment shall be free of excess paint and shall be legible.
- C. Where stenciling is not appropriate for equipment identification, engraved nameplates shall be used.
- D. Identify piping not less than once every 30 feet, not less than once in each room, adjacent to each access door or panel, and on both side of the partition where exposed piping passes through walls, floors or roofs. Place flow directional arrows at each pipe identification location. Use one coat of black enamel against a light background or white enamel against a dark background.
- E. For steam piping systems, include in the pipe identification the design pressure of the piping system. For example, a high pressure steam piping system designed to operate at 125 PSI shall be labeled "HIGH PRESSURE STEAM 125 PSIG". The design pressure shall also be identified on low-pressure steam piping systems.
- F. Identify valves with brass tags bearing system identification and a valve sequence number. Valve tags are not required at a terminal device unless the valves are greater than ten feet from the device or located in another room not visible from the terminal unit. Provide a typewritten valve schedule indicating the valve number and the equipment or areas supplied by each valve; locate schedules in each mechanical room and in each Operating and Maintenance manual. Schedules in mechanical rooms shall be framed under clear plastic.
- G. Use engraved nameplates to identify control equipment and motor starters. Motor starters shall be provided with an engraved nameplate identifying the piece of equipment it serves by plan identification (i.e. "AHU-1").
- H. Identify all fire and smoke dampers. Dampers shall be permanently identified on the exterior of the duct with a label (or painted) having a minimum letter height of 1". Identification shall read either "FIRE DAMPER", "SMOKE DAMPER" or "FIRE/SMOKE DAMPER".

### 3.12 LUBRICATION

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

### 3.13 PROJECT CLOSEOUT

- A. Contractor shall provide the following submittal data prior to final site walk-through review (found on next page). If this closeout work is not completed or is inaccurately completed, the Contractor shall be responsible for the expense of additional site reviews made by A/E.

END OF SECTION

|   |
|---|
| CLOSEOUT DATA SUBMITTALS  |
| Record drawing submission   |
| Air balance test reports  |
| Operating and maintenance manuals   |
| Instructional walk-through and training   |
| Piping and valve identification charts  |
| Inspectors test reports<br>- Fire department inspector<br>- HVAC inspector                              |
| Pipe pressure test report<br>- Gas piping leak test<br>- Refrigerant leak test                          |
| System startup reports<br>- Heating equipment<br>- Cooling equipment<br>- Temperature control equipment |
| Closeout statements<br>- Work completion<br>- Warranty statements<br>- Punch list completion            |

## SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes requirements for single and three phase motors that are used with equipment specified in other sections. Also included are general requirements for electrical wiring and electrical connections. Included are the following requirements:

#### 1.2 RELATED WORK

- A. Section 2305 00 – Common Work Results for HVAC
- B. Section 23 05 14 - Variable Frequency Drives
- C. Section 23 09 23 – Direct Digital Control Systems for HVAC
- D. Division 26 – Electrical
- E. All electrical and temperature control wiring installation shall conform to the requirements of the applicable electrical sections of these specifications.

#### 1.3 REFERENCE

- A. Provisions of Division 01 govern work under this section.

#### 1.4 REFERENCE STANDARDS

- A. ANSI/IEEE 112        Test Procedure for Polyphase Induction Motors and Generators
- B. ANSI/NEMA MG-1    Motors and Generators
- C. ANSI/NEMA MG1-31
- D. ANSI/NFPA 70        National Electrical Code

#### 1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.

#### 1.6 SUBMITTALS

- A. Submit shop drawings for motors and motor starters.
- B. For standalone motors and equipment furnished with motors, include with the equipment which the motor drives, the following motor information: motor manufacturer, horsepower, voltage, phase, hertz, RPM, full load efficiency, related power factor and installation and maintenance instructions.
- C. Submit wiring diagrams for motors and HVAC equipment requiring wiring by the Electrical Contractor for this project. Wiring diagrams shall be prepared by the Contractor specifically for this work.

## 1.7 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Include manufacturer's instructions in the manuals with the specific equipment to which they apply. Also include the following information if not previously documented on shop drawings: full load power factor, service factor, NEMA design designation, insulation class, and frame type.

## 1.8 ELECTRICAL COORDINATION AND GENERAL REQUIREMENTS

- A. All starters, overload relay heater coils, disconnect switches and fuses, relays, wire, conduit, push-buttons, pilot lights, and other devices required for the control of motors or electrical equipment will be furnished and installed by the Electrical Contractor, except as specifically noted elsewhere in this division of specifications.
- B. The drawings and specifications show number and horsepower rating of motors furnished by this Contractor, together with their actuating devices if these devices are furnished by the HVAC Contractor. Any discrepancy in size, horsepower rating, electrical characteristics, or means of control for motors or other electrical equipment after contracts are awarded, and shall be addressed with the A/E.
- C. Costs involved in changes required due to equipment substitutions initiated by this contractor will be the responsibility of the contractor. See related comments in Section 23 05 00, Basic HVAC Requirements, under Submittals.
- D. The Contractor shall be responsible for providing control wiring (line and low voltage) for the project unless noted otherwise, including but not exclusive to the following:
  - 1. Interlock wiring of line and low voltage motorized automatic dampers associated with fans.
- E. Furnish project specific wiring diagrams to Electrical Contractor for equipment, starters and devices furnished by this Contractor and indicated to be wired by the Electrical Contractor.
- F. Provide on the front enclosure face of starting equipment, selector switches and push-buttons stations, a securely mounted, laminated plastic engraved name plate which shall identify the motorized equipment served by the respective starter. The name tags shall be constructed of black and white plastic (black face and white lettering) with ¼" high lettering. The lettering shall identify the unit served by the plan identification mark (example: "Exhaust Fan EF-1").

## 1.9 PRODUCT CRITERIA

- A. Motors to conform to applicable requirements of NEMA, IEEE, ANSI, and NEC standards and shall be listed by UL for the service specified.
- B. Select motors for conditions in which they will be required to perform; i.e., general purpose, splash-proof, explosion proof, standard duty, high torque or other special type by the equipment or motor manufacturer's recommendations and as specified on the drawings and as specified herein.
- C. Furnish motors for starting in accordance with utility requirements and with compatible starters as specified.
- D. All motors over 1 HP shall meet the minimum efficiency requirements as specified under Wisconsin Code, COMM 63.32 requirements (table 63.32). Coordinate with the



respective supplier(s) of motors for the project to meet minimum efficiency requirements. Note special minimum motor efficiencies as specified on the plans or within the project specifications.

## PART 2 - PRODUCTS

### 2.1 MOTORS

#### A. SINGLE PHASE, SINGLE SPEED MOTORS

1. Use NEMA rated 120 volt, single phase, 60 hertz motors for motors 1/3 HP and smaller.
2. Use permanent split capacitor or capacitor start, induction run motors equipped with permanently lubricated and sealed ball or sleeve bearings and Class B insulation. Service factor to be not less than 1.35. Motors are to be provided with internal overload protection.

#### B. THREE PHASE, SINGLE SPEED MOTORS

1. Use NEMA rated three phase, 60 hertz motors for motors ½ HP and larger unless specifically indicated. Refer to plans for voltage requirements.
2. Use NEMA general purpose, continuous duty, Design B, normal starting torque, T-frame or U-frame motors with Class B or better insulation unless the manufacturer of the equipment on which the motor is being used has different requirements. Use open drip-proof motors unless totally enclosed fan-cooled, totally enclosed non-ventilated, explosion-proof, or encapsulated motors are specified in the equipment sections or otherwise indicated on the drawings.
3. Use grease lubricated anti-friction ball bearings with housings equipped with plugged/capped provision for lubrication, rated for minimum AFBMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at the end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
4. Open drip-proof motors shall have a 1.15 service factor. Other motor types may have minimum 1.0 service factors.
5. All motors 1 HP and larger, except specially wound motors and inline pump motors 56 frame and smaller, to be premium efficiency design with full load efficiencies which meet or exceed the values listed below when tested in accordance with NEMA MG 1.

#### FULL LOAD NOMINAL MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED

| -----Open Drip-Proof Motors----- |          |          |          |  |
|----------------------------------|----------|----------|----------|--|
| -----Nominal Motor Speed-----    |          |          |          |  |
| MOTOR<br>HP                      | 1200 rpm | 1800 rpm | 3600 rpm |  |
| 1                                | 82.5     | 85.5     | 80.0     |  |
| 1-1/2                            | 86.5     | 86.5     | 85.5     |  |
| 2                                | 87.5     | 86.5     | 86.5     |  |
| 3                                | 89.5     | 89.5     | 86.5     |  |
| 5                                | 89.5     | 89.5     | 89.5     |  |
| 7-1/2                            | 91.7     | 91.0     | 89.5     |  |
| 10                               | 91.7     | 91.7     | 90.2     |  |

| ----Totally Enclosed Fan-Cooled---- |          |          |          |  |
|-------------------------------------|----------|----------|----------|--|
| -----Nominal Motor Speed-----       |          |          |          |  |
| MOTOR<br>HP                         | 1200 rpm | 1800 rpm | 3600 rpm |  |
| 1                                   | 82.5     | 85.5     | 78.5     |  |
| 1-1/2                               | 87.5     | 86.5     | 85.5     |  |

|       |      |      |      |
|-------|------|------|------|
| 2     | 88.5 | 86.5 | 86.5 |
| 3     | 89.5 | 89.5 | 88.5 |
| 5     | 89.5 | 89.5 | 89.5 |
| 7-1/2 | 91.7 | 91.7 | 91.0 |
| 10    | 91.7 | 91.7 | 91.7 |

C. **THREE PHASE, TWO-SPEED MOTORS**

1. Unless otherwise indicated, three phase two speed motors shall be one winding, consequent pole, variable torque type, and single phase two speed motors shall be capacitor start, capacitor run type having two capacitors in parallel with run capacitor remaining in circuit at operating speeds. Motors shall also meet above requirements for 3 phase single speed motors.

**PART 3 - EXECUTION**

**3.01 MOTOR INSTALLATION**

- A. Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot to get a secure installation.
- B. When motor are flexible coupled to the driven device, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Using a dial indicator, check angular misalignment of the two shafts; adjust motor position so that the angular misalignment of the shafts does not exceed 0.002 inches per inch diameter of the coupling hub. Again using the dial indicator, check the shaft for run-out for concentricity of the shafts; adjust so that run-out does not exceed 0.002 inch.
- C. When motor are connected to the driven device by means of a belt drive, mount sheaves on the appropriate shafts in accordance with the manufacturer's instructions. Use a straight edge to check alignment of the sheaves; reposition sheaves so that the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so that the belt(s) can be added and tighten the base so that the belt tension is in accordance with the drive manufacturer's recommendations. Frequently recheck belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.
- D. Lubricate motors requiring lubrication. Record lubrication material used and the frequency of use. Include this information in the maintenance manuals.

**END OF SECTION**

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

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes specifications for supports of HVAC equipment and materials as well as piping system hangers and anchors.

#### 1.2 RELATED WORK

- A. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
- B. Section 23 07 00 – HVAC Insulation

#### 1.3 REFERENCE

- A. Provisions of Division 01 shall govern work under this section.

#### 1.4 REFERENCE STANDARDS

- A. U.L. Underwriters Laboratory
- B. ASME B31.1 ASME Code For Pressure Piping
- C. MSS SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture
- D. MSS SP-69 Pipe Hangers and Supports - Selection and Application
- E. MSS SP-89 Pipe Hangers and Supports – Fabrication & Installation Practices
- F. MSS SP-90 Guidelines on Terminology for Pipe Hangers and Supports
- G. Federal Specification WW-H-171E

#### 1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.

#### 1.6 DESCRIPTION

- A. Provide supporting devices for the installation of mechanical equipment and materials. Supports and installation procedures are to conform to the latest requirements of the ANSI/ASME Code for pressure piping.
- B. Do not hang mechanical items directly from a metal deck or run piping so it rests on the bottom chord of trusses or joists.
- C. 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.
- D. Protect insulation at hanger points; see Related Work above.

## 1.7 SUBMITTALS

- A. Submit shop drawings for equipment roof curbs, equipment roof rails and roof pipe portals.

## 1.8 DESIGN CRITERIA

- A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless noted otherwise.
- B. Piping supported by laying on the bottom chord of joists or trusses is not acceptable.
- C. Use galvanized hangers in lieu of black hangers in wet areas. Wet areas are those spaces that normally can have water in them (shower rooms, for example) or that could have water during normal maintenance and repair. The latter area includes equipment rooms containing expansion tanks, boilers, chillers, water coils; it does not include the space above suspended ceilings.

## PART 2 - PRODUCTS

### 2.1 STRUCTURAL SUPPORTS

- A. Provide supporting steel for the installation of mechanical equipment and materials, whether or not it is specifically indicated or sized, including angles, channels and beams to suspend or floor support tanks, piping, and other HVAC equipment.

### 2.2 PIPE HANGER AND SUPPORT MANUFACTURERS

- A. Grinnell figure numbers are listed below. Equivalent products by B-Line, Fee and Mason, Kindorf, Michigan Hanger or Unistrut are acceptable.

### 2.3 PIPE HANGERS AND SUPPORTS

- A. Black hangers are specified below. Substitute equivalent galvanized hangers for use in wet areas or areas that are frequently washed down.
- B. STEEL PIPING SYSTEMS OPERATING AT 250° F OR LESS
  - 1. Hangers for Pipe sizes ½" through 2½": Carbon steel, adjustable clevis, black finish.
    - a. Grinnell Figure 65 or 260
    - b. Provide Grinnell Figure 167 insulation protection shield for each hanger on insulated piping systems.
  - 2. Multiple or Trapeze Hangers: Steel channels with welded spacers, or unistrut with hanger rods.
    - a. Grinnell Figure 46.
    - b. Provide Grinnell Figure 167 insulation protection shield for each hanger on insulated piping systems.
  - 3. Wall Support: Welded steel bracket with hanger. Support shall be selected for the application.
    - a. Grinnell Figure 195/199 with hanger as specified above.

4. Floor Support for Pipe sizes up to 6": Cast iron adjustable pipe saddle, locknut nipple, and special cast iron reducer. Provide with steel support pipe, and steel plate floor flange.
  - a. Grinnell Figure 264
5. Floor Support for Pipe Elbow Risers: Steel pipe stanchion with steel support pipe, and steel floor plate.
  - a. Grinnell Figure 63

#### 2.4 BEAM CLAMPS

- A. MSS SP-69 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. Grinnell Figure 86.
- B. MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place for rod sizes to 1 1/2 inch diameter but limited in application to pipe sizes 8 inch and less without prior approval. Grinnell Figure 228.

#### 2.5 CONCRETE INSERTS

- A. MSS SP-69 Type 18 wedge type or universal concrete inserts.
- B. Wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. Wedge design to allow the insert to be held by concrete in compression. Grinnell Fig. 281.
- C. Universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. Grinnell Fig. 282.
- D. Use drilled steel shell with plug type inserts when the inserts are placed after the concrete is poured. These inserts are not to depend on soft lead for holding power.

#### 2.6 PIPE HANGER RODS

- A. Steel Hanger Rods
  1. Threaded both ends, threaded one end, or continuous threaded, black finish.
  2. Size rods for individual hangers and trapeze support according to the following schedule.
  3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

| <u>Maximum Load (Lbs.)</u> | <u>Rod Diameter (Inches)</u> |
|----------------------------|------------------------------|
| 610                        | 3/8                          |
| 1130                       | 1/2                          |
| 1810                       | 5/8                          |
| 2710                       | 3/4                          |
| 3770                       | 7/8                          |
| 4960                       | 1                            |
| 8000                       | 1 1/4                        |

4. Provide rods with adjusting and lock nuts.
5. Maximum temperature shall not exceed 650° F.

**B. HEIGHT OF SUPPORTS**

1. Based on the length of the main support member, the height of the support member above the roof deck to be as follows:

| <u>Length of Support<br/>Member (inches)</u> | <u>Min. Height of Support<br/>Above Deck (inches)</u> |
|--|---|
| up to 36                                     | 12  |
| 37 - 60                                      | 18  |
| 61 and over                                  | 24  |

**2.7 EQUIPMENT STANDS**

- A. Use contractor fabricated stand consisting of structural steel members supported by pipe supports. Pipe supports shall be securely fastened to the floor structure. Steel exposed to the weather to be galvanized or stainless.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install supports to provide for free expansion of the piping and duct system. Support piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- B. Coordinate hanger and support installation to properly group piping of other trades.
- C. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and data is submitted for prior approval.
- D. Piping over 1 1/4" shall be attached so that weight is carried on the top chord of steel bar joists or purlins.

**3.2 HANGER AND SUPPORT SPACING**

- A. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
- B. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- C. Support riser piping independently of connected horizontal piping.
- D. Adjust hangers to obtain the slope specified in the piping section of this specification.

E. SPACE HANGERS FOR PIPE AS FOLLOWS

| <u>Pipe Material</u> | <u>Pipe Size</u> | <u>Max. Horizontal</u> | <u>Max Vertical</u> |
|----------------------|------------------|------------------------|---------------------|
|                      |                  | <u>Spacing</u>         | <u>Spacing</u>      |
| Steel                | ½" through 1¼"   | 6' - 0"                | 15' - 0"            |
| Steel                | 1½"              | 8' - 0"                | 15' - 0"            |
| Steel                | 2" through 4"    | 10' - 0"               | 15' - 0"            |
| PVC                  | All sizes        | 4' - 0"                | 10' - 0"            |
| Copper               | ½" through 1"    | 6' - 0"                | 10' - 0"            |
| Copper               | 1¼" and larger   | 10' - 0"               | 10' - 0"            |

3.3 CONCRETE INSERTS

- A. Select size based on the manufacturer's stated load capacity and weight of material being supported. Locate continuous insert channels on 8' - 0" maximum centers and 2' - 0" from corners. Furnish inserts to the General Contractor for placement in concrete formwork. Use insets for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inch size. Where concrete slabs form finished ceiling, provide inserts that are flush with the slab surface.
- B. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with the slab.

3.4 EQUIPMENT STANDS

- A. Height of pipe support to be selected from the following table, based on the maximum width of the equipment being supported:

| <u>Length of Support</u><br><u>Member (inches)</u> | <u>Min. Height of Support</u><br><u>Above Deck (inches)</u> |
|--|---|
| up to 24   | 14  |
| 25 - 36  | 18  |
| 37 - 48  | 24  |
| 49 - 60  | 30  |
| 61 and over  | 48  |

- B. Weld vertical pipe supports to horizontal support members. Apply two coats of zinc rich paint to cut edges and welded areas of galvanized steel elements.

END OF SECTION

This Page Intentionally Left Blank



## SECTION 23 05 93 - TESTING, ADJUSTING AND BALANCING

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes specifications for air and water testing, adjusting and balancing (TAB) specifications for the entire project. Included are the following requirements:

#### 1.2 RELATED WORK

- A. Section 23 05 00 – Common Work Results for HVAC submittals to be furnished for use by the testing and balancing agency for coordination of work.
- B. Project drawings and specifications which define the scope of the systems to be balanced.

#### 1.3 REFERENCE

- A. Provisions of Division 1 govern work under this section.

#### 1.4 REFERENCE STANDARDS

- A. AABC        National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems, Fifth Edition, 1989.
- B. ASHRAE     ASHRAE Handbook, 1987 HVAC Systems and Applications, Chapter 57, Testing Adjusting and Balancing.
- C. NEBB        Procedural Standards for Testing Adjusting Balancing of Environmental Systems, Latest Edition.

#### 1.5 QUALITY ASSURANCE

- A. Testing, adjusting and balancing of new air systems, including electrical measurement and verification of performance of equipment shall be completed in accordance with standards published by AABC or NEBB.
- B. Air balancing work shall be completed by an AABC or NEBB certified air balance contractor. Certification number and seal of registration shall be included with each balancing report.

#### 1.6 DESCRIPTION

- A. Provide mechanical systems testing, adjusting and balancing. Requirements include the balancing of air systems, including adjustment of new and existing systems to provide design quantities as specified on the drawings, electrical measurement and verification of performance of equipment.
- B. Test, adjust and balance air and hydronic systems so that each room, piece of equipment or terminal device is using the quantities indicated on the drawings and in the specifications.
- C. Accomplish testing, adjusting and balancing work in a timely manner that allows partial occupancy of major buildings, occupancy of one building when the project

involves many buildings, and completion of the entire project in the time stated in the Instruction to Bidders and in accordance with the completion schedule established for this project. Coordinate with other sections of work as specified to provide timely and accurate completion of the TAB work.

- D. The test and balance agency is encouraged to make periodic site visits to make sure that provisions are being made to accomplish the specified testing, adjusting and balancing work. If problems are found, handle as specified in Part 3 under Deficiencies.

## 1.7 COORDINATION

- A. The testing, adjusting and balancing Contractor shall coordinate his work with the mechanical system and temperature control system installing Contractors to accomplish coordination and verification of system operation and readiness for testing, adjusting and balancing.

## 1.8 SUBMITTALS

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

- B. Submission

- 1. Submit 5 sets of reports for distribution. Final distribution of submittals shall be as follows:
    - a. Owner 3 copies for record purposes after approval (to be included in the operation and maintenance manuals).
    - b. Project Architect 1 copy for record purposes after approval.
    - c. Project Engineer 1 copy for record purposes after approval.
    - d. Contractor 1 copy for record purposes after approval.
  - 2. Include a copy of the approved final balancing report for this project.

- C. Format

- 1. Bind report forms in three-ring binders or portfolio binders. Label edge or front with label identifying project name, project number and descriptive title of contents. Divide the contents of the report into the below listed divisions, separated by divider tabs:
    - a. General Information
    - b. Summary
    - c. Air Systems
    - d. Special Systems

- D. Contents

- 1. Provide the following minimum information, forms and data:
    - a. General Information: Inside cover sheet identifying Test and Balance Agency, Contractor, Architect, Engineer, Project Name and Project Number. Include addresses, contact names and telephone numbers. Also include a certification sheet containing the seal and signature of the Test and Balance Supervisor.
    - b. Summary: Provide summary sheet describing mechanical system deficiencies. Describe objectionable noise or drafts found during testing, adjusting and balancing. Provide recommendations for correcting

unsatisfactory performances and indicate whether modifications required are within the scope of the contract, are design related or installation related. List instrumentation used during testing, adjusting and balancing procedures.

- c. The remainder of the report to contain the appropriate standard NEBB or AABC forms for each respective item and system. Fill out forms completely including the percent deviation from design values. Where information cannot be obtained or is not applicable indicate same.

## PART 2 - PRODUCTS

### 2.1 INSTRUMENTATION

- A. Provide required instrumentation to obtain proper measurements. Application of instruments and accuracy of instruments and measurements are to be in accordance with the requirements of NEBB or AABC Standards and instrument manufacturer's specifications.
- B. All instruments used for measurements shall be accurate, and calibration histories for each instrument shall be available for examination upon request. Calibration and maintenance of instruments shall be in accordance with the requirements of NEBB or AABC Standards

## PART 3 - EXECUTION

### 3.1 PRELIMINARY PROCEDURES

- A. Check filters for cleanliness, dampers for correct positioning, equipment for proper rotation and belt tension, temperature controls for completion of installation.
- B. Do not proceed until systems are fully operational with components necessary for complete testing, adjusting and balancing. Installing Contractors are required to provide personnel to check and verify system completion, readiness for balancing and assist Balancing Agency in providing specified system performance.

### 3.2 PERFORMING TESTING, ADJUSTING AND BALANCING

- A. Perform testing, adjusting and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards except as may be modified below.
- B. Unless specifically instructed in writing, work specified in this section is to be performed during the normal workday.
- C. In areas containing ceilings, remove ceiling tile to accomplish balancing work; replace tile when work is complete and provide new tiles for tiles that are damaged by this procedure. If the ceiling construction requires the installation of access panels for completion of work under this section, provide panels for access as necessary.
- D. Cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary for adequate performance of procedures. Patch using materials identical to those removed, maintaining vapor barrier integrity and pressure rating of systems.

- E. In air systems employing filters, blank off filter area to simulate a pressure drop that is midway between that of a clean filter and that of a dirty filter.
- F. Adjust equipment to yield specified total flow at terminals. Proceed taking measurements in mains and branches for final terminal balancing. Perform terminal balancing to specified flows balancing branch dampers, deflectors, extractors and valves prior to adjustment of terminals.
- G. Determine air handling system total supply and return airflow and return and exhaust fan total airflow at each piece of equipment utilizing a pitot tube duct traverse. Summation of air terminal inlet/outlet CFM's is not acceptable, unless a pitot tube traverse is impractical. If summation of the air inlets/outlets is used in lieu of the traverse method, a valid explanation shall be submitted along with the balancing reports. Insufficient back-up information to support use of the summation method is cause for rejection of the balancing reports without review.
- H. Measure and record airflow and static air pressure conditions across fans, coils and filters. Indicate in report if cooling coil measurements were made on a wet or dry coil and if filter measurements were made on a clean or dirty filter. Spot check static air pressure conditions directly ahead of terminal units. Submit a static pressure profile for each air handling unit system. Unit static pressure profile shall be done at both minimum outside air CFM and at maximum outside air CFM (full economizer cycle) and also with the face and bypass dampers (when provided on air handling systems) in full bypass position as well as full face position. Reports submitted without air handling system static pressure profiles is cause for rejection of the balancing reports without review.
- I. Adjust outside air, return air and relief air dampers for design conditions at both the minimum and maximum settings and record both sets of data. Balance modulating dampers at extreme conditions and record both sets of data. Balance variable air volume systems at maximum air flow rate, full cooling, and minimum flow rate, full heating; record all data.
- J. Provide fan and motor drive sheave adjustments to obtain design performance. If fan and motor drive sheaves require replacement to obtain design air volumes, provide sheave replacements at no additional cost to the project. Design air volume shall be obtained at all air handling unit operating conditions – minimum outside air and 100% outside air (economizer position) for all face and bypass damper positions (full face and full bypass).
- K. Final air system measurements to be within the following range of specified CFM:
  - 1. Fans -5% to +10%
- L. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation and any deficiencies found.
- M. Permanently mark equipment settings, including damper positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.
- N. Leave systems in proper working order, replacing belt guards, closing access doors and electrical boxes, and restoring temperature controls to normal operating settings.

### 3.3 DEFICIENCIES

- A. Contractor shall correct installation deficiencies found during the test and balance stage. Test and balance agency shall notify the Construction Representative of these items.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 23 07 00 - HVAC INSULATION

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes insulation specifications for heating, ventilating, and air conditioning piping, ductwork, and equipment.

#### 1.2 RELATED WORK

- A. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- B. Section 23 31 00 – HVAC Ducts and Casings

#### 1.3 REFERENCE

- A. Provisions of Division 01 govern work under this section.

#### 1.4 REFERENCE STANDARDS

- A. ASTM/ANSI C195 Mineral Fiber Thermal Insulation Cement
- B. ASTM/ANSI C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- C. ASTM/ANSI C533 Calcium Silicate Block and Pipe Thermal Insulation
- D. ASTM/ANSI C547 Mineral Fiber Preformed Pipe Insulation
- E. ASTM/ANSI C552 Cellular Glass Block and Pipe Thermal Insulation
- F. ASTM/ANSI C553 Mineral Fiber Blanket and Felt Insulation
- G. ASTM/ANSI C578 Preformed, Block Type Cellular Polystyrene Thermal Insulation
- H. ASTM/ANSI C612 Mineral Fiber Block and Board Thermal Insulation
- I. ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate
- J. ASTM C449 Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement
- K. ASTM C610 Expanded Perlite Block and Thermal Pipe Insulation
- L. ASTM E84 Surface Burning Characteristics of Building Materials
- M. NFPA 225 Surface Burning Characteristics of Building Materials
- N. NFPA 96 Ventilation Control and Fire Protection of Commercial Cooking Operations

- O. MICA Manual            National Commercial & Industrial Insulation Standards, 1988, Third Edition, published by the Midwest Insulation Contractors Association
  - P. UL 723                Surface Burning Characteristics of Building Materials
- 1.5      QUALITY ASSURANCE
- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.
  - B. Label insulating products delivered to the construction site with the manufacturer's name and description of materials.
- 1.6      SUBMITTALS
- A. Include manufacturer's data for the following:
    - 1. Duct Insulation
    - 2. Equipment Insulation
  - B. Insulation submittal shall include data on thermal conductivity, materials of composition, jacket information and temperature limitations. Include in the submittals a schedule of insulation types and thickness for each type (and size) of surface to be insulated. Include in the schedule a listing of specialty type jackets for the applications required for the project.
- 1.7      DESCRIPTION
- A. Furnish and install insulating materials and accessories as specified. The following types of insulation are specified in this section:
    - 1. Duct Insulation
    - 2. Equipment Insulation
  - B. Install insulation materials in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions. Exceptions to these standards will only be accepted where specifically modified in these specifications, or where prior written approval has been obtained from the Engineer.
- 1.8      DEFINITIONS
- A. "Concealed"
    - 1. Shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.
  - B. "Unconditioned spaces"
    - 1. Unheated or non-cooled attics, utility tunnels and crawl spaces where ambient temperatures may rise above 90°F, or drop below 50°. Ducts in these instances are considered to be located outside of the building thermal envelope.



## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Materials or accessories containing asbestos will not be accepted.
- B. Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less except that outdoor mechanical insulation may have a flame spread rating of 75 and a smoke developed rating of 150.

### 2.2 INSULATION AND JACKETS

#### A. MANUFACTURERS:

- 1. Armstrong, Halstead, Owens-Corning, Johns-Manville, Knauf, Certainteed or equivalent to types as specified herein.
- 2. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be capable of receiving jackets, adhesives and coatings for the required application.
- 3. Jackets shall have puncture resistance based on ASTM D-781 test methods. Vapor barriers, where required, shall have perm ratings based on ASTM E-96 procedure A.

#### B. FLEXIBLE FIBERGLASS INSULATION

- 1. Owens-Corning "All-Service Duct Wrap" or Johns-Manville "R" Series Microlite with a minimum density of 0.75 lb. per cu. ft., thermal conductivity of not more than 0.35 at 75°F mean temperature, and be suitable for an operating temperature up to 250°F. Vapor retarder facing shall be a foil-scrim-kraft laminate jacket, factory applied to the insulation. Permeance shall not exceed 0.02 perms when tested in accordance with ASTM E 96. Beach puncture resistance shall be 50 units minimum.

#### C. RIGID FIBERGLASS INSULATION - PIPING

- 1. Owens-Corning SSL-II having a thermal conductivity of not more than 0.23 at 75°F mean temperature and a maximum operating temperatures of 450°F.
- 2. Jacket: White kraft reinforced vapor barrier all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of 0.02 perms (aged) and minimum beach puncture resistance of 50 units.
- 3. Provide jacket of 6 oz. per sq. yd. fiberglass cloth embedded in 2 coats of weatherproof mastic. Field or factory applied stainless steel or aluminum jacket may be substituted for fiberglass cloth jacket at contractors option.

#### D. ELASTOMERIC INSULATION

- 1. Armstrong AP Armaflex or Armaflex II or Halstead F/R Insul-Tube closed cell insulation, with minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75°F mean temperature, and maximum water vapor transmission of 0.17 perm inch. The material shall have an acceptable application temperature range from 220°F to -40°F.
- 2. No jacket is required for inside applications unless specified or noted otherwise.

E. PROTECTIVE METAL JACKETS

1. Constructed of .020 inch thick aluminum or .010 inch thick stainless steel with longitudinal Pittsburgh Z-Lock seam. End to end joints must be lapped a minimum of 2 inches and be sealed with vapor barrier mastic. Jacket shall be secured using metal bands for end to end joints, and rivets or sheetmetal screws for longitudinal joints. Rivets, screws, and bands shall be constructed of the same material as the jacket. Provide 2 piece preformed metal jackets at fitting locations.

2.3 ACCESSORIES

- A. Products shall be compatible with surfaces and materials on which they are applied, and be compatible for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands to be  $\frac{3}{4}$  inch wide, constructed of aluminum or stainless steel. Minimum thickness to be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- D. Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.
- E. Finishing cement to be ASTM C449.
- F. Fibrous glass cloth shall have a minimum untreated weight of 6 oz./sq. yd.
- G. Bedding compounds to be non-shrinking and permanently flexible.
- H. Vapor barrier coatings to be non-flammable, fire resistant, polymeric resin.
- I. Wire mesh reinforcing shall be corrosion resistant metal with a hexagonal pattern.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Do not insulate systems or equipment that is specified to be pressure tested or inspected, until testing and inspection have been successfully completed.
- B. Piping, ductwork, and equipment shall be installed with clearances from walls, piping, ductwork, equipment and other obstacles to permit the application of the full thickness of insulation as specified.
- C. Insulation, jackets, or accessories shall only be installed under ambient temperatures or conditions recommended by the manufacturer of the material.
- D. Insulation and jackets shall be provided as specified in the listings contained within this specification section, or as otherwise noted on the plans. Requirements apply to both exposed and concealed applications unless noted otherwise.

- E. Install insulation with smooth and even surfaces, and on clean and dry surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled terminations at nameplates, uninsulated fittings, and at other locations where insulation terminates.
- F. Use full length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation will not be accepted.
- G. Provide removable insulation sections to permit easy access where inspection, service, or repair is required.
- H. Install jackets with longitudinal joints facing wall or ceiling.
- I. Insulation shall be continuous through sleeves and openings except where partitions or assemblies are fire rated. Penetrations through rated assemblies shall be sealed with fireproofing insulation.
- J. Provide a continuous vapor barrier for insulation on the following systems:
  - 1. Refrigerant
  - 2. Insulated duct
  - 3. Equipment with a surface temperature below 65° F.
- K. Glass fabric reinforcing shall be installed in accordance with manufacturer's recommendations, and fitted without unnecessary wrinkles or seams. Seams shall overlap a minimum of 2 inches.

### 3.2 PIPING, VALVE AND FITTING INSULATION

- A. Fittings and valves may be insulated with factory molded "Zeston" type covers, or built up insulation. Built up insulation must have the same thickness as adjoining insulation.
- B. Insulation shall be applied to piping with butt joints and longitudinal seams closed tightly.
- C. Minimum acceptable lap on factory applied jackets shall be 2 inches, firmly cemented with lap adhesive.
- D. Joints shall be covered with factory furnished tape (2" minimum width) to match the jacket, firmly cemented with lap adhesive.
- E. Install insulation with smooth and even surfaces, and on clean and dry surfaces. Provide neatly beveled terminations. Poorly fitted terminations or use of filler in voids will not be accepted.
- F. Provide metal jacketing for the following piping:
  - 1. Exterior piping
- G. Where metal jackets are used for exterior applications, locate seams on bottom side of horizontal piping.
- H. Where anchors or supports are secured directly to the pipe, extend insulation up the anchor or support for a distance of 4 times the insulation thickness. Maintain vapor barrier where insulation is terminated.

- I. Elastomeric insulation shall be slipped onto the pipe prior to connection wherever possible. Where the slip on technique is not possible, the insulation shall be slit, and applied to the pipe. Seams and butt joints shall be sealed with an adhesive recommended by the insulation manufacturer.
- J. On insulated piping with vapor barrier, insulate fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints. Insulation for valves, unions, strainers, flexible connections and expansion joints shall be removable for inspection and repair.
- K. Provide insulation as specified in the following schedule for all new piping:

| Service                 | Insulation       | Insulation Thickness by Pipe Size |              |              |          |               |
|-------------------------|------------------|-----------------------------------|--------------|--------------|----------|---------------|
|                         |                  | Type 1" and smaller               | 1 1/4" to 2" | 2 1/2" to 4" | 5" to 6" | 8" and larger |
| Refrigerant Suction     | rigid fiberglass | 1"                                | 1 1/2"       | 1 1/2"       | 1 1/2"   | 1 1/2"        |
| Hot Gas Bypass          | rigid fiberglass | 1"                                | 1 1/2"       | 1 1/2"       | 1 1/2"   | 1 1/2"        |
| Hot Gas                 | elastomeric      | 1/2"                              | 1/2"         | 1/2"         | 1/2"     | 1/2"          |
| Cooling Coil Condensate | rigid fiberglass | 1"                                | 1"           | 1"           | 1"       | 1"            |

- L. Provide a protective metal jacket for insulated piping exposed to the weather, or where potential physical damage could occur.

### 3.3 DUCT INSULATION

- A. Where ductwork is specified to be pressure tested, do not insulate duct until pressure test has been successfully completed.
- B. Duct insulation shall be applied evenly over the duct surface, secured with bonding adhesive in accordance with manufacturer's recommendations.
- C. Rigid and flexible insulation on sides and bottom of ductwork over 24" wide shall also be secured with stick clip or weld pin fasteners spaced 18" on center. Where weld pin fasteners are used, they shall be installed without damage to the interior galvanized surface of the duct. Pins to be neatly clipped back to each fastener.
- D. Where vapor barrier jackets are specified, pins shall be covered with jacket material matching that of the duct insulation, sealed vapor tight, and covered with vapor barrier mastic.
- E. Insulation without factory jacket shall be cut and mitered to suit the surface on which it is being applied. Voids, seams, and joints shall be built up with insulating cement, finished to a smooth surface, and covered with glass fabric.
- F. For ductwork surfaces insulated with rigid ductboard insulation, apply 2 coats of vapor barrier mastic after application of the insulating cement. Vapor barrier and weatherproof mastics to be applied with glass fiber reinforcing fabric.
- G. Surface of duct must be cleaned before application of adhesives.
- H. Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation or jacket material.

- I. Joints and seams of jackets for rigid fiberglass insulation shall be firmly butted together and covered with 6" wide glass cloth set in mastic. After first coat of mastic is dry, apply a second coat.
- J. Where reinforced kraft jackets are used, joints and seams shall be firmly butted together and covered with 3" wide tape furnished by jacket manufacturer, and specifically recommended for the type of jacket being used.
- K. On exterior ducts use mechanical fasteners for insulation. Provide overlapping insulation joints on exterior applications. Seal joints, breaks, and penetrations of vapor barrier facing with a vapor barrier tape as recommended by jacket manufacturer. Apply two coats of weatherproof mastic covering over the duct insulation with a glass fabric jacket between the two coats. Mastic surface shall have a smooth outside finish.
- L. For coils in air systems, maintain the continuity of duct insulation over and around coils. This includes coils duct mounted coils. Vapor barriers on cold coils shall be maintained continuous.
- M. Provide duct insulation as specified in the following table for all [new] [new and existing] ductwork:

| Service   | Insulation Type     | Insulation Thickness |
|---|---------------------|----------------------|
| Outside air intake ducts  | Flexible fiberglass | 2"                   |
| Mixed air* ducts  | Flexible fiberglass | 2"                   |
| Relief air ducts  | Flexible fiberglass | 2"                   |
| Bypass ductwork   | Flexible fiberglass | 2"                   |
| Concealed supply ducts  | Flexible fiberglass | 1½"                  |
| Exposed supply ducts in equipment rooms and other non-finished areas            | Flexible fiberglass | 1½"                  |
| Exposed supply ducts in Finished/occupied areas                                 | Flexible fiberglass | 1½"                  |
| Exposed supply ducts in Exhaust ducts downstream of motorized backdraft dampers | Flexible fiberglass | 1½"                  |
| Exhaust ducts downstream of heat recovery units                                 | Flexible fiberglass | 1"                   |
| Heat recovery units   | Flexible fiberglass | 1"                   |

\* - Mixed air ducts include bypass ducts for coil face and bypass applications.

- N. Ductwork specified to be dual wall construction is not required to be externally insulated unless specifically noted on the plans.

### 3.4 EQUIPMENT INSULATION

- A. Where equipment is specified to be leak tested prior to operation, do not install insulation until testing and necessary repairs have been successfully completed.
- B. Insulation shall be applied to equipment shells with bonding adhesive, and wired in place. Fill joints and seams with insulating cement, covering surfaces with a wire reinforcing mesh. An additional coat of insulating cement with glass cloth shall then be applied, and finished to a smooth, hard surface.

- C. Where a vapor barrier is required, apply 2 coats of vapor barrier mastic after application of the insulating cement.
- D. Where a vapor barrier is not required, apply 2 coats of weatherproof mastic after application of the insulating cement.
- E. Provide insulated boxes with metal protective jacket where access is required for cleaning, repair, or inspection. Boxes must be easily removable without causing damage to insulation or equipment.
- F. Air handling unit casings, chambers, or plenums (filters, mixing chambers and sound attenuators) and inline fans shall be insulated in accordance with requirements of adjacent duct insulation.
- G. Do not insulate equipment that is factory insulated.
- H. Do not insulate over equipment nameplates or ASME stamps. Bevel and seal insulation at these locations.
- I. Insulation on chilled water pumps shall extend from the point of piping connection, down around the pump housing and onto the pump base.
- J. Provide equipment insulation as follows:

| Equipment Type                                    | Insulation Type     | Insulation Thickness |
|---|---------------------|----------------------|
| Filter housings                                   | Flexible fiberglass | 2"                   |
| Exhaust Fans downstream of<br>Heat recovery units | Elastomeric         | 1"                   |

END OF SECTION

## SECTION 23 09 23 - DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. Work in this section includes, field equipment panels, software programming, and other equipment and accessories necessary to constitute a complete, fully functional Direct Digital Control (DDC) building automation system, utilizing Direct Digital Control signals to meet, in every respect, all operational and quality standards specified herein.

#### 1.2 REFERENCE

- A. Applicable provisions of Division 01 shall govern work under this section.

#### 1.3 RELATED WORK

- A. Section 23 05 00 – Common Work Results for HVAC
- B. Section 23 09 93 – Sequence of Operation for HVAC Controls
- C. Division 26 – Electrical

#### 1.4 WORK OF OTHER SECTIONS

- A. Power wiring for starters.
- B. Furnishing of disconnect switches required by Code at motor locations.
- C. Installing and wiring motor starters.

#### 1.5 DEFINITIONS

- A. The following definitions are applicable to work of this section:
  - 1. DDC Direct Digital Control
  - 2. BAS Building Automation System
  - 3. TCS Temperature Control System
  - 4. TCC Temperature Control Contractor
  - 5. I/O Input/output Device
  - 6. FMS Facility Management System
  - 7. LAN Local Area Network
  - 8. DCU Distributed Control Units
  - 9. ASC Application Specific Controller

#### 1.6 DESCRIPTION OF WORK

- A. The extent of the work shall be as shown on the drawings, as shown in schedules and as detailed by the performance requirements specified hereinafter.
- B. All necessary software, hardware, firmware, operating equipment, devices and system components required for the system shall be provided by the Subcontractor whether or not specifically itemized, in order to provide a complete system within the intent of this specification.

- C. All system point types shall be universal I/O. All hardware inputs shall be digital inputs or analog inputs (field selectable). All hardware outputs shall be digital outputs or analog outputs (field selectable). Float control will not be allowed unless true analog feedback is used on a per point basis.
- D. It is the intent of this specification to describe a system utilizing the latest technology with an emphasis towards "connectivity". The BAS system shall in no way hinder the ability of the Owner to purchase mechanical equipment of multiple equipment manufacturers at this time or in the future.
- E. ALL exceptions to bid specifications shall be clearly listed with the BAS bid for Owner/Engineer review. ANY exceptions not listed shall bind the contractor to the full extent of the specifications. All questions and comments shall be directed in writing to the engineer.

#### 1.7 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.
- B. MANUFACTURER
  - 1. Provide principal direct digital temperature control equipment and materials as manufactured by a single manufacturer.
- C. ELECTRICAL STANDARDS
  - 1. Provide electrical products which have been tested, listed and labeled by Underwriters' Laboratories (UL) and comply with NEMA standards.
- D. DDC Standards
  - 1. Manufacturer shall provide written proof with shop drawings that the equipment being provided is in compliance with F.C.C. rules governing the control of interference caused by Digital Electronic Equipment to Radio Communications (1979 Amendment to Part 15, Subpart J).

#### 1.8 SUBMITTALS

- A. Submittals shall be required in two phases.
- B. First phase (approval) submittals
  - 1. First phase (approval) submittals, to be done on AutoCAD, shall include job-tailored shop drawings as detailed herein, individual catalog cut sheets detailing manufacturer's data for each major control system component listed under Section 4, "Materials and Equipment", general catalog for all other minor control components and descriptive sequences detailing all automatic control system work. Generalized, standard catalog shop drawings shall not be used for first phase (approval) submittals. This Subcontractor shall develop a complete set of new shop drawings showing the entire automatic control system including the new digital automatic control system and the FMS system interface.
  - 2. Each shop drawing shall be provided with a title block identifying the name of the project, the address of the project, the address of the Subcontractor, the shop drawing sheet number, the Subcontractor's in-house project identification number and the mechanical system reproof the latest revision made to the individual shop drawing.



3. Each mechanical system shall be represented by a line diagram showing each mechanical component (supply fans, heating coils, cooling coils, etc.) as well as any other mechanical system components present but not necessarily affected by the automatic control system (filters, etc.).
4. A line diagram representation of the respective mechanical system shall show all dampers in their relative locations (outside air ductwork, return air ductwork, etc.) and shall show all valves as they are intended to be connected to their respective mechanical component for proper operation.
5. A line diagram representation of the respective mechanical system shall also show all field-mounted automatic control system sensing and control components (sensors, transmitters, receiver-controllers, etc.) and all controlled devices (pressure-electric switches, electric-pressure solenoids, damper actuators, valve actuators, etc.).
6. All panel-mounted control components shall be shown within a separate section of the shop drawing designated for representation of the individual control panel and its face layout. Interconnecting pneumatic piping between panel-mounted components shall be shown. Interconnecting electrical wiring shall not be shown within the designated panel section of the shop drawing but shall be detailed in a one-line diagram (complete with terminal designations) on the same drawing.
7. All electrical wiring for starters of mechanical system components affected by the automatic control system (supply fans, exhaust fans, pumps, etc.) shall be represented as one-line diagrams showing all interlocks between the automatic control system, the respective starter and any other interlocks not necessarily provided as part of the automatic control system (fire alarm, smoke alarm, etc.).
8. Each shop drawing shall be accompanied by a typewritten listing identifying each control system component shown on that drawing. Each component shall be identified by the name used to designate the component on the shop drawings, the component's actual catalog description and designation (to be used when purchasing repair parts), the component's operating range, the component's fail-safe position, the component's setpoint (where applicable) and any other pertinent information.
9. Each shop drawing shall be accompanied by a typewritten sequence of operation identifying the designated function of each control component shown on that drawing. Each control component shall be identified in the sequence of operation by the name used to designate the component on the shop drawings.
10. Each sequence of operation detailing a control sequence involving more than one controlled device (damper operator, valve operator, etc.) shall be accompanied by a sequence graph identifying the relative position of the respective controlled device in the overall sequence (above and below the setpoint of the control loop controlling the respective device.)
11. First phase (approval) submittals shall be provided to and approved by the Owner's authorized representative before any job site installation work is performed.

C. Second phase (operation and maintenance) submittals

1. Second phase (operation and maintenance) submittals shall be provided after all installation, calibration and start-up work has been completed and shall include the first phase submittal shop drawings of the automatic control system, revised to reflect the system in its as-built condition, along with all information previously included in the first phase submittals.
2. Each second phase (operation and maintenance) submittal shall include a typewritten set of operating instructions identifying the procedures to be employed to perform such automatic control system operations as overriding the system,

entering new setpoints, displaying current values of system parameters, displaying trend logs, etc.

3. Second phase (operation and maintenance) submittals shall also include information detailing preventive maintenance to be performed by the Owner on a regular basis and the Subcontractor's system guarantee and system component warranties.
4. All as-builts shall be on AutoCAD and both a hard copy and 3.5" disk shall be included with O&M manuals.

#### 1.9 OPERATOR INSTRUCTION

- D. On-site operator instruction shall be provided during normal working hours and shall be performed by competent representatives of the BAS/TCS Subcontractor familiar with the overall BAS/TCS software, hardware and accessories.
- E. On-site operator instruction relevant to the BAS/TCS shall include, but not be limited to the overall operational program, equipment functions (both individually and as part of the total integrated system), commands, system generation, advisories, and appropriate operator intervention required in responding to the BAS/TCS operation, a description of the chronological information flow from field sensors, contacts and devices to the BAS/TCS and an overview of the BAS/TCS communication network explaining the interplay between initiating devices, field data-gathering panels, system communications and their importance within the operating system.
- F. Additional instruction time as deemed necessary by the Owner shall be obtained from the BAS/TCS Subcontractor on a negotiated basis with the Owner.
- G. Provide at the time of instruction, three copies of the Owner's operation and maintenance manual, custom-prepared for this project by the BAS/TCS Subcontractor, which shall be used in conjunction with the instruction. Each copy of the Owner's manual shall be bound in a three-ring binder, labeled with the name and address of the project.

#### 1.10 MATERIAL DELIVERY AND STORAGE

- A. Provide factory-shipping cartons for each piece of equipment and control device. This contractor is responsible for storage of equipment and materials inside and protected from the weather.

### PART 2 - PRODUCTS

#### 2.1 APPROVED MANUFACTURERS

- A. Honeywell

#### 2.2 POWER FAIL/AUTO RESTART

- A. Provide for the automatic orderly and predefined shutdown of parts or all of the FMS following total loss of power to parts or all of the FMS.
- B. Provide for the automatic orderly and predefined startup of parts or all of the FMS following total loss of power to those parts or all of the FMS. Archive and annunciate time and details of restoration.

- C. Provide for the orderly and predefined scheduling of controlled return to normal, automatically time scheduled, operation of controlled equipment as a result of the auto restart processes.
- D. Maintain the FMS real-time clock operation during periods of power outage for a minimum of 72 hours.

## 2.3 DOWNLOADING AND UPLOADING

- A. Provide the capability to generate FMS software-based sequences, database items and associated operational definition information and user-required revisions to same at any Operator PC, and the means to download same to the associated Application Node.
- B. Application software tool used for the generation of custom logic sequences shall be resident in both the application node and the server(s) where indicated on the drawings.
- C. Provide the capability to upload FMS operating software information, database items, sequences and alarms to the designated server(s).
- D. The functions of this Part shall be governed by the codes, approvals and regulations applying to each individual FMS application.

## 2.4 OPERATOR INTERFACE

### A. GENERAL

- 1. User access to the control system shall be protected by a flexible and Owner redefinable software-based password access protection. Password protection shall be multi-level and partitionable to accommodate the varied access requirements of the different user groups. Provide the means to define unique access privileges for each individual authorized user. Also provide the means to establish general password groups to which an individual will then be assigned. Once assigned to the group each individual will assume all the capabilities and restrictions of that group. Provide the means to on-line manage password access control under the control of a Master Password.

### B. ALARMS

- 1. Alarms shall be routed directly from primary application nodes to a pager. The alarm management portion of the software shall, at the minimum, provide the following functions:
  - a. Log date and time of alarm occurrence.
  - b. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
  - c. Provide the ability to direct alarms to an e-mail address or alpha-numeric pager. This must be provided in addition to the pop up window described above. Systems which use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
  - d. Any attribute of any object in the system may be designated to report an alarm.
- 2. The control system shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.
- 3. The control system shall annunciate application alarms at minimum, as required by Part 3.

### C. SCHEDULES

1. The system shall provide multiple schedule input forms for automatic time-of-day scheduling and override scheduling of operations. At a minimum, the following types shall be accommodated:
  - a. Weekly schedules.
  - b. Temporary override schedules.
  - c. Special "Only Active If Today Is A Holiday" schedules.
  - d. Monthly schedules.
2. Schedules shall be provided for each system or sub-system in the control system. Each schedule shall include all commandable points residing within the system. Each point may have a unique schedule of operation relative to the system use schedule, allowing for sequential starting and control of equipment within the system. Scheduling and rescheduling of points shall be accomplished easily via the system schedule spreadsheets.
3. Monthly calendars for a 12-month period shall be provided that allow for simplified scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the weekly schedules.

## 2.5 APPLICATION SOFTWARE

### A. HVAC APPLICATION SOFTWARE

1. Event Messaging: Provide for the automatic execution of user-defined messages on the occurrence of each predefined real-time event including equipment/point status change, approaching limit or alarm, time of day and the like. Direct messages to any number of operator PCs, e-mail destinations, and pagers.
2. Auto Alarm Lockout: Provide for scheduled and automatic lockout of alarm annunciation from equipment during non-normal operating conditions including shutdown, emergency power operation, fire alarm and the like.
3. Energy monitoring: Provide software to monitor and totalize consumption as measured by pulse meters.
4. Event Initiated Programs and custom logic: Provide software to define custom logic sequences that will reside in the nodes. The definition software will also reside in the node and be accessible via the standard user interface via a browser.
5. System Restart: Upon restoration of the AC power to an HVAC Node, automatically restart all equipment and restore all loads to the state as required by the controls. Provide appropriate time delays to prevent demand surges or overload trips.

## 2.6 FUNCTIONAL REQUIREMENTS

### A. APPLICATION SPECIFIC CONTROLLER INTERFACE

1. It shall not be necessary to calculate and enter Proportional, Integral, Derivative, or Interval values in order to engineer, startup or commission the ASCs. The ASCs shall be shipped with default parameters which can be adjusted if required. Standard default parameters will be different for each application.

### B. APPLICATION SPECIFIC CONTROLLER - COMMON REQUIREMENTS

1. Inputs shall be software definable to accept Thermistor or Discrete Contact Closure. Outputs shall be TRIAC, and shall support Two Position, Frequency Modulated, Pulse Width Modulated and Floating.
2. Connectors for field wiring shall be easily removable without disconnecting the cabling.

3. LED indication shall be provided for communications status and controller self diagnostics status.
4. Setpoint bias, local override, and room temperature shall be available via the room sensor or a plain Thermistor based sensor, using the same terminals.
5. The room sensor shall support a hand held console
6. The ASC shall be UL Listed for UL 916 Energy Management Systems. Any plastics used (i.e., cover, etc.) shall be UL Listed for UL 94-V0 (self extinguishing materials).
7. The ASC shall be field configurable for standalone operation, without power to the unit, using DIP switches, or similar methods. The ASC shall operate with the new settings immediately and not require a power cycle to initiate them. Each ASC shall ship from the factory pre-programmed with common default values.
8. Editors, set points, addresses, etc. shall remain in NOVRAM or EEPROM, to ensure standalone operation. It shall be possible to read and write to this memory, locally and remotely to make changes to the default parameters. Parameters requiring ongoing changes will reside in RAM, and default to the NOVRAM or EEPROM values.
9. The ASC shall contain a seven day software clock which shall be accurate to five (5) minutes per day. This software clock is intended to be used for initial commissioning prior to connecting to the communication bus, as well as a “fallback” for when communication with the bus is lost. The hardware clock in the communication bus shall automatically update the software clocks in the ASC’s once per day, to ensure best accuracy during occupancy hours.
10. The ASCs shall support one-step calibration of temperature sensors and velocity transducers. Eliminate the need for a technician, test & balance contractor, or Owner to have to refer to look-up tables or to interpolate “counts” in calibration or recalibration of an input or output.
11. Staging will be automatic. If one stage is required, analog outputs will vary between 0 and 100% as the load calculation varies between 0 and 100%. If two stages are required, stage one analog output will vary between 0 and 100% as the load calculation varies between 0 and 50%, and stage two analog output will vary between 0 and 100% as the load calculation varies between 50 and 100%. Digital outputs will also be staged and modulated using time proportioned modulation over a fixed window (i.e., 5 or 10 minutes). If one stage is required the first stage will be on for  $\frac{1}{4}$  the time window for a 25% load calculation,  $\frac{1}{2}$  the time window for a 50% load calculation, etc. If two stages are required, the first stage will be on 100% at 50% load calculation, and the second stage will be on for  $\frac{1}{2}$  its time window at 75% load calculation.
12. The currently active zone temperature set points (as biased by setpoint adjustment) shall be available for dynamic displays, and use in other system applications.
13. Fans, compressors, heat stages, and the like shall have minimum on and maximum off times. It shall be possible to lockout heating and cooling centrally. Fans shall be interlocked to operate when stages of heat or cooling are operational.
14. Resident I/O database shall support minimum trip and close. Default minimum fan cycle times = 30 seconds and minimum compressor cycle time = 4 minutes. These values shall be adjustable.
15. Provide for points to be predefined based on how they are wired to certain terminals. For applications which do not fully utilize all points in an application, the unused point may be any defined for other applications resident in the MCI or other controllers..

### C. INTELLIGENT SENSORS

1. Where shown on the plans, provide “intelligent” space sensors for Application Specific Controllers which have the following features:
  - a. 3 digit (plus decimal) alphanumeric display.
  - b. A means to locally controller analog or digital points in the connected controller.
  - c. Local override and setpoint adjustment (within software limits).
  - d. Occupancy status LED and On/Off push-button.
  - e. A “call” push-button that can be linked to an Event Initiated Program anywhere in the system.
  - f. Display of all local input and output points in the service mode for ASCs.
  - g. Display of up to 4 user defined “global” or system points (e.g., outside air temperature, outside air RH, fan status).
  - h. Password protection of access to service mode, with a selection of up to 1000 passwords for ASC.
2. Space sensors shall have an integral port for connection of a portable “intelligent” sensor to communicate with its ASC. This port and portable “intelligent” sensor may be used for initiating the “test mode” locally to verify all ASC control sequences, and perform test and balancing functions. To eliminate the downtime associated with rechargeable batteries, the portable “intelligent” sensor shall receive its power from the sensor port.

### 2.7 CONTROL DAMPERS

- A. Furnish control dampers shown on the plans and as required to perform the specified functions.
- B. Acceptable Manufacturers of air dampers are Ruskin model CD-36 or equivalent Johnson Controls, Air Balance, Advanced Air, Cesco, American Warming and Ventilating, Vent Products Company Inc., Greenheck or Arrow damper products.
- C. Use only factory fabricated, low leakage type dampers with replaceable resilient blade seals, stainless steel jamb seals and with entire assembly suitable for the maximum temperature and air velocities encountered in the system.
- D. All dampers for shut-off or isolation service to be UL 555S Class 2 leakage rated at 250°F.
- E. Dampers used for mixing of airstreams to be parallel blade type, sized for air velocity of 1800 to 2000 fpm. Dampers used for throttling or modulating applications other than air stream mixing to be opposed blade type. Two position dampers may be parallel or opposed blade type.
- F. Dampers for applications other than fume exhaust to have frames of not less than 16 gauge galvanized steel or 12 gauge extruded aluminum. Blades to be not less than 16 gauge galvanized steel for single thickness, 22 gauge galvanized steel for double thickness, or 14-gauge aluminum, with steel rod, bronze or nylon bearings. Maximum allowable blade width is 8 inches. Use zinc plated steel linkage hardware.
- G. Maximum damper width is 48 inches; where required width exceeds 48 inches, use multiple dampers. Minimum size for duct-mounted dampers is 90% of duct size.
- H. Damper operators shall be Belimo or Johnson Controls, Inc. electric type compatible with the DDC control system. Use direct mount, synchronized operating, bi-directional,

fail-safe operators. Provide operators with linkages and brackets for mounting on device served as required.

- I. Size operators for smooth and positive operation of devices served, and with sufficient capacity to provide tight shutoff against system temperatures and pressure encountered. Equip operators with spring return for applications involving fire, freeze protection, moisture protection or specified normally open/closed operation.
- J. Provide operators with linkages and brackets for mounting on device served.

## 2.8 MISCELLANEOUS SENSORS

### A. CURRENT SENSORS

- 1. Provide for each fan specified, or shown on point list as requiring this device a current sensor with adjustable threshold and digital output with LED display, equal to a Veris model H-708.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. This Contractor shall provide all labor, materials, engineering, software permits, tools, check-out and certificates required to install a complete automation system as herein specified. This system shall fully communicate through all I/O devices, central processing unit (CPU), and digital communication trunks. This digital communications trunk shall be true bi-directional analog and digital communications.
- B. All electronic work required as an integral part of the automation system work is the responsibility of this section unless specifically indicated otherwise in this section or in Division 16.
- C. BAS vendor shall demonstrate the ability to upgrade 5 year of BAS hardware to operate with the latest release software revisions. This shall be done with "Firmware Chip" additions only. No integrators shall be allowed. A system expansion with lessor capabilities will not be accepted. This contractor shall provide evidence of having done five (5) similar installations and shall insure that the system installation will not alter the UL listing of the new system.
- D. Install system and materials in accordance with manufacturer's instructions, rough-in drawings and details on drawings.

### 3.2 ELECTRICAL

- A. All work and materials are to conform in every detail to the rules and requirements of the Wisconsin Electrical Code and present manufacturing standards. All material shall be UL approved.
- B. This Contractor shall be responsible for all line voltage and low voltage electrical wiring incidental to the system installation.
- C. All sensor and output wiring shall be shielded cable as required by the equipment manufacturer.

- D. The field wiring connections of all field-mounted sensors shall be adequately protected by a junction box mounted at the point of measurement.
- E. Separate conduit systems shall be provided for sensor wiring and high voltage (120 VAC) wiring.
- F. All low voltage exposed wiring provided by this Contractor shall be enclosed in conduit (EMT). All line voltage provided by this Contractor shall be enclosed in conduit (EMT).
- G. All conduit shall be secured at regular intervals and run parallel with the lines of the building.
- H. Power to local temperature control panels shall be provided by the BAS Contractor.
- I. Control panels serving equipment fed by emergency power shall also be served by emergency power.
- J. All line voltage wiring required to power the DDC Controllers shall be provided by BAS contractor.
- K. BAS Identification Standards:
  - 1. Node Identification. All nodes shall be identified by a permanent label fastened to the outside of the enclosure. Labels shall be suitable for the node location.
  - 2. Cable shall be labeled at a minimum of every 18" with the FMS System manufacturer's name and the type of signal carried within the cable, i.e. Analog Input, Analog Output, Binary Input, Binary Output, 24 VAC.
  - 3. Each of the cable types specified in Item A shall be of a different color coding for easy identification and troubleshooting. Recommended color coding:
    - a. Analog Input Cable      Yellow
    - b. Analog Output Cable      Tan
    - c. Binary Input Cable      Orange
    - d. Binary Output Cable      Violet
    - e. 24 VAC Cable      Gray
    - f. General Purpose Cable      Natural
    - g. Tier 1 Comm Cable      Purple
    - h. Other Tier Comm Cable      Blue
- L. Raceway Identification. All the covers to junction and pull boxes of the FMS raceways shall be painted with the appropriate color.
- M. Wire Identification - all low and line voltage FMS wiring shall be identified by a number, as referenced to the associated shop drawing and as-built drawing, at each end of the conductor or cable. Identification number shall be permanently secured to the conductor or cable and shall be typed.

### 3.3 CONTROL DAMPERS

- A. All control dampers furnished by the control manufacturer are to be installed by the Mechanical Contractor under the coordinating control and supervision of the Control Contractor in locations shown on plans or where required to provide specified sequence of control.



- B. Coordinate installation with the sheetmetal installer to obtain smooth duct transitions where dampers size is different than duct size. Blank off plates will not be accepted.
- C. Each operator shall serve a maximum damper area of 30 square feet. Where larger dampers are used, provide multiple operators.

#### 3.4 ROOM THERMOSTATS AND TEMPERATURE SENSORS

- A. Check and verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate room thermostats 48 inches above floor. Align with light switches and humidistats.
- B. Any room thermostats mounted on an exterior wall shall be mounted on a thermally insulated sub-base.

#### 3.5 COMMISSIONING

- A. Fully commission all aspects of the Facility Management System work.
- B. Acceptance Check Sheet:
  - 1. Prepare a check sheet that includes all points for all functions of the FMS
  - 2. Submit the check sheet to the Engineer for approval one month prior to testing.
  - 3. Complete the check sheet for all items and functions of the FMS and initial each entry with time/date as record of having fully calibrated and tested the FMS. Submit to Engineer.
  - 4. The Engineer will use the check sheet as the basis for acceptance testing with the FMS Contractor.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 23 09 93 - SEQUENCE OF OPERATION FOR HVAC CONTROLS

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes control sequences describing the manner in which the automatic control systems shall operate. Included are the following requirements:

#### 1.2 RELATED WORK

- A. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
- B. Section 23 09 14 – Pneumatic and Electric Instrumentation and Control Devices for HVAC
- C. Section 23 09 23 – Direct Digital Control System for HVAC

#### 1.3 REFERENCE

- A. Provisions of Division 01 govern work under this section.

#### 1.4 SUBMITTALS

- A. The following data/information shall be submitted for approval. This data shall be included with the balance of the Section 23 09 23 submittals:
  - 1. Complete sequence of operation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Refer to Section 23 09 23.

### PART 3 - EXECUTION

#### 3.1 CONTROL SEQUENCES - DESCRIPTION OF WORK

- A. Control sequence is hereby defined to mean the manner in which, and methods by which, the automatic temperature control system shall function. The requirements for each type of operation are detailed in this section.
- B. All necessary operating equipment, devices and system components required for the automatic temperature control system shall be provided by the Automatic Temperature Control Subcontractor whether or not specifically itemized, in order to install a complete automatic temperature control system within the intent of this specification.
- C. The extent of the automatic temperature control system work shall be as shown on the drawings and by the control performance requirements as specified in this section.
- D. In each equipment room, provide a minimum of 1 temperature control panel. The temperature control panel shall have a local control and interface display panel to

monitor specified equipment alarms, reset values, equipment statuses and runtimes. Alarms and system points shall be capable of being viewed from this location. Points shall also be able to be controlled or alarms acknowledged from this location.

- E. The Temperature Control Contractor (TCC) shall provide and field install required sensors to provide the points as specified on the points lists, as well as additional sensors and points to provide the specified sequence of operation. For equipment that has a factory supplied microprocessor controllers (including, but not limited to chillers and packaged rooftop air conditioning equipment), provide the necessary interfaces and communication wiring as well as additional field installed sensors to monitor the specified points. These sensors may be either analog or binary depending on the application.

### 3.2 VARIABLE VOLUME MIXED AIR FURNACE CONTROL (F-1, F-2 AND F-3):

#### A. General:

1. Three constant volume furnaces plenumed together.
2. The furnaces are controlled by direct digital controller (DDC).
3. The furnaces are equipped with the following:
  - a. Supply fan.
  - b. Supply air damper furnished by TCC. (Refer to specification 23 09 14)
  - c. Return air damper furnished by TCC. (Refer to specification 23 09 14)
  - d. Direct Expansion (DX) coil for cooling.
  - e. Modulating gas fired heat exchanger.
  - f. Filter bank.
  - g. Actuators furnished by TCC. (Refer to specification 23 09 14)

#### B. FAN CONTROL:

1. Start/Stop: The control system shall start the supply.
2. For fan systems with three supply fan shall operate during the occupied time. When fan status is proven on, command the isolation damper open and release the fan to control. If a fan status does not prove on or the isolation damper end switch does not prove open within 2 minutes (adj.) of the fan start or damper open commands, command the supply fan off and the isolation damper closed, latch out this supply fan, and send a supply fan failure alarm through the DDC system. Provide a manual push-button switch located in the control panel and a software point to reset the shutdown latch out of the fan. When stopping a lag fan, command the damper to close and ramp the fan down to minimum speed at the same rate as the damper actuator stroke time (typically 90 seconds). After the damper end switch indicates the damper is closed, command the fan off. When switching lead fans and stopping a lag fan, prove operation of the new lead fan and allow 2 minutes (adj.) for the fan to come up to speed before initiating the stop fan sequence. Provide a software point and hardware switch located inside the control panel for each fan to be taken out of service that will initiate the shutdown sequence for the fan. If there is a lag fan that is available, it's start sequence shall be initiated and come into control before the shutdown sequence for the fan being taken out of service is stopped.
3. Current Status Switch: Provide as described under GENERAL, in this Section for the supply fans.

#### C. Ventilation Air Control:

1. Fixed Ventilation Air Flow Setpoint: The furnaces will receive outside air ventilation from the energy recovery ventilator during occupied time.

- D. Filters:
1. Install a differential static pressure sensor across each filter bank. Ensure that the static probes do not impede filter removal.
  2. For filter bank, provide an alarm to the operator interface when the differential static pressure exceeds 1.0" W.C. (adj.).
- E. SPACE TEMPERATURE CONTROL:
1. Install a temperature sensor in the space as indicated on drawings.
  2. Discharge Air Temperature Setpoint: Space temperature setpoint shall be 68° F (adj.) in heating and 78° F (adj.) in cooling during occupied times. Space temperature setpoint shall be 50° F (adj.) in heating and not controlled for cooling during unoccupied times.
  3. Space Control: The gas fired heat exchangers and the DX cooling coils shall be controlled in sequence to maintain the space setpoint temperature. At no time shall the gas fired heat exchanger be operating when the Air Cooled Condensing unit is operating. Whenever the space temperature is above the setpoint, the following shall occur in sequence: The gas control valve shall modulate closed as sequenced below. When heating is completely off the air cooled condensing units and furnace fans will cycle on to maintain the space temperature setpoint. When the discharge air setpoint is below setpoint the reverse shall occur. Air cooled condensing units control shall be locked out below 40° F (adj.) outside air temperature.
  4. Gas Fired Heat Exchanger Control: Modulate the gas control valve as sequenced under space temperature control. If the space temperature cannot be maintain by the lead furnace then stage on a lag furnace and modulate gas control valves together to maintain space temperature. If require stage on the third furnace in the same way.
- F. SAFETIES:
1. General: All safeties shall be hard wired to the supply and return fan starters or VFD safety circuits. Starters shall not function in the "Hand" or "Auto" and VFD's shall be disabled if they are indexed to the "Auto" or "Hand" position in either the VFD or bypass modes.
  2. Freezestat: Install an electric freezestat (refer to specification Section 23 09 14 for location) to shut down the unit (see Unit Shutdown for additional information) if the temperature downstream of the heating coil drops below 35° F (adj.). The electric freezestat shall act independently of the DDC system via hardwire interlock and shall override the DDC system control signal to open the heating coil control valve(s). A freezestat trip shall notify the DDC system that shall send an alarm to the operator interface.
  3. Fire Alarm Shutdown: Upon a Fire Alarm System alarm, the fire alarm control module provided by the electrical contractor at the temperature control panel shall change state of its contacts. This shall cause the unit to be shut down (see Unit Shutdown for additional information) and all fire/smoke and smoke dampers within this system shall close immediately through a hardwire interlock. An auxiliary contact shall be provided to notify the DDC system of a fire alarm shutdown. See Section 28 31 00 for fire alarm system programming requirements.

G. Unit Shutdown:

1. Whenever the furnaces are indexed off, the supply fans shall stop. On a failure of a supply fan, an alarm will be sent through the DDC system. Whenever all supply fans are off for any reason the following shall occur:
2. The supply air dampers and the return dampers shall close.
3. The air cooled condensing unit shall be off.
4. The gas control valve(s) shall be off.

H. Unoccupied Control:

1. General: Occupied/unoccupied schedule shall be set at the DDC operator interface. When indexed to unoccupied the unit shall shutdown. Where provided, index DDC controlled heating and cooling terminal units associated with this air handling unit to maintain setback and setup temperature setpoints unless overridden by occupancy sensor or manual pushbutton.
2. Unit Cycling to Maintain Setback/Setup Temperatures: Cycle the air handling unit on to maintain the setback and setup temperature zone setpoints to maintain 58 °F and 86 °F respectively. Reset supply return fan volume offset for return air fan control to zero. Supply fan shall be limited to the maximum return fan airflow. In the heating mode, the outside air and relief air dampers shall close and the return air damper shall open and heating discharge temperature control shall function as specified. In the cooling mode, the economizer and chilled water discharge temperature control shall be allowed to function as specified. Minimum on runtime timer shall be set for 15 minutes (adj.) and the off timer for 30 minutes (adj.).

3.3 CONSTANT VOLUME ENERGY RECOVERY VENTILATOR UNIT CONTROL (ERV-1):

A. General:

1. The Air Handling unit is constant air volume, indoor air unit.
2. The Air Handling unit is controlled by direct digital controller (DDC).
3. The Air Handling unit is equipped with the following:
  - a. Supply fan with starter.
  - b. Exhaust fan with starter.
  - c. Outside air damper furnished by Temperature Control Contractor (TCC). (Refer to specification 23 09 14)
  - d. Return air damper furnished by TCC. (Refer to specification 23 09 14)
  - e. Relief air damper furnished by TCC. (Refer to specification 23 09 14)
  - f. Cross plate energy recovery heat exchanger.
  - g. Filter Bank
  - h. Actuators furnished by TCC. (Refer to specification 23 09 14)

B. FAN CONTROL:

1. Start/Stop: The DDC system shall start and stop the supply and exhaust fan. Fans shall operate during occupied times only.
2. Current Status Switch: Provide for both supply and exhasut fans and set up as described under GENERAL, Current Switch Setup, in this Section.

C. VENTILATION AIR Control:

1. Minimum Outside Ventilation Air Flow Control: This unit will operate only during occupied times to provide the required ventilation air for the building. The control contractor shall work with the balancing contractor to establish the minimum scheduled ventilation airflow.

D. Filters:

1. Install a differential static pressure sensor across each filter bank. Ensure that the static probes do not impede filter removal.
  2. For filter bank, provide an alarm to the operator interface when the differential static pressure exceeds 1.0" W.C (adj.).
- E. SAFETIES:
1. General: All safeties shall be hard wired to the supply and return fan starters or VFD safety circuits. Starters shall not function in the "Hand" or "Auto" and VFD's shall be disabled if they are indexed to the "Auto" or "Hand" position in either the VFD or bypass modes.
  2. Fire Alarm Shutdown: Upon a Fire Alarm System alarm, the fire alarm control module provided by the electrical contractor at the temperature control panel shall change state of its contacts. This shall cause the unit to be shut down (see Unit Shutdown for additional information). An auxiliary contact shall be provided to notify the DDC system of a fire alarm shutdown.
- F. UNIT Shutdown:
1. Whenever the ERV unit is indexed off, the supply and exhaust fans shall stop. If the exhaust fan fails off, the supply fan shall be indexed off. On a failure of either the supply or return fan, an alarm will be sent through the DDC system. Whenever both supply and return fans are off for any reason the following shall occur:
  2. The outside air dampers and relief air dampers shall close and the return dampers shall open.
- G. UNOCCUPIED Control:
1. General: Occupied/unoccupied schedule shall be set at the DDC operator interface. When indexed to unoccupied the unit shall shutdown. Where provided, index DDC controlled heating and cooling terminal units associated with this air handling unit to maintain setback and setup temperature setpoints unless overridden by occupancy sensor or manual pushbutton.
- 3.4 TERMINAL UNIT CONTROL – DDC AND ELECTRIC:
- A. CABINET AND UNIT HEATER CONTROL:
1. Provide an electric space thermostat to maintain space temperature.

END OF SECTION

This Page Intentionally Left Blank



## SECTION 23 09 93 - SEQUENCE OF OPERATION FOR HVAC CONTROLS

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes control sequences describing the manner in which the automatic control systems shall operate. Included are the following requirements:

#### 1.2 RELATED WORK

- A. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
- B. Section 23 09 23 – Direct Digital Control System for HVAC

#### 1.3 REFERENCE

- A. Provisions of Division 01 govern work under this section.

#### 1.4 SUBMITTALS

- A. The following data/information shall be submitted for approval. This data shall be included with the balance of the Section 23 09 23 submittals:
  - 1. Complete sequence of operation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Refer to Section 23 09 23.

### PART 3 - EXECUTION

#### 3.1 CONTROL SEQUENCES - DESCRIPTION OF WORK

- A. Control sequence is hereby defined to mean the manner in which, and methods by which, the automatic temperature control system shall function. The requirements for each type of operation are detailed in this section.
- B. All necessary operating equipment, devices and system components required for the automatic temperature control system shall be provided by the Automatic Temperature Control Subcontractor whether or not specifically itemized, in order to install a complete automatic temperature control system within the intent of this specification.
- C. The extent of the automatic temperature control system work shall be as shown on the drawings and by the control performance requirements as specified in this section.
- D. In each equipment room, provide a minimum of 1 temperature control panel. The temperature control panel shall have a local control and interface display panel or provide a network interface to the existing Honeywell WEBS-AX Supervisor to monitor specified equipment alarms, reset values, equipment statuses and runtimes, Occupied/Unoccupied Schedules. Alarms and system points shall be capable of being

viewed from this location. Points shall also be able to be controlled or alarms acknowledged from this location.

- E. The Temperature Control Contractor (TCC) shall provide and field install required sensors to provide the points as specified, as well as additional sensors and points to provide the specified sequence of operation. For equipment that has a factory supplied microprocessor controllers (including, but not limited to chillers and packaged rooftop air conditioning equipment), provide the necessary interfaces and communication wiring as well as additional field installed sensors to monitor the specified points. These sensors may be either analog or binary depending on the application.

### 3.2 CONSTANT/STAGED VOLUME MIXED AIR FURNACE CONTROL (F-1, F-2 AND F-3):

#### A. General:

1. The furnaces shall have be controlled for occupied and unoccupied based on a schedule, [remote start](#) or as override by lights turned on within the building. During unoccupied times the furnaces, gas valves and air cooled condensing units shall stage on/off to maintain the space temperature. During occupied times the furnaces shall turn on all fans and operate at a constant speed. The gas burners shall modulate/stage on to maintain space temperature. The air cooled condensing units shall stage on to maintain space temperature
2. Three constant volume furnaces plenumed together.
3. The furnaces are controlled by direct digital controller (DDC).
4. The furnaces are equipped with the following:
  - a. Supply fan.
  - b. Supply air damper furnished by TCC. (Refer to specification 23 09 14)
  - c. Return air damper furnished by TCC. (Refer to specification 23 09 14)
  - d. Direct Expansion (DX) coil for cooling.
  - e. Modulating gas fired heat exchanger.
  - f. Filter bank.
  - g. Actuators furnished by TCC. (Refer to specification 23 09 14)

#### B. FAN CONTROL:

1. Start/Stop: The control system shall start the supply fans.
2. For fan systems with three supply fan shall operate during the occupied time. When fan status is proven on, command the isolation damper open and release the fan to control. If a fan status does not prove on or the isolation damper end switch does not prove open within 2 minutes (adj.) of the fan start or damper open commands, command the supply fan off and the isolation damper closed, latch out this supply fan, and send a supply fan failure alarm through the DDC system. Provide a manual push-button switch located in the control panel and a software point to reset the shutdown latch out of the fan. After the damper end switch indicates the damper is closed, command the fan off. Provide a software point and hardware switch located inside the control panel for each fan to be taken out of service that will initiate the shutdown sequence for the fan.
3. Current Status Switch: Provide as described under GENERAL, in this Section for the supply fans.

#### C. Ventilation Air Control:

1. Fixed Ventilation Air Flow Setpoint: The furnaces will receive outside air ventilation from the energy recovery ventilator during occupied time.

D. SPACE TEMPERATURE CONTROL:

1. Install a temperature sensor in the space as indicated on drawings.
2. Discharge Air Temperature Setpoint: Space temperature setpoint shall be 68° F (adj.) in heating and 78° F (adj.) in cooling during occupied times. ~~Space temperature setpoint shall be 50° F (adj.) in heating and not controlled for cooling during unoccupied times.~~
3. Space Control:
  - a. Occupied Mode: The gas fired heat exchangers and the DX cooling coils shall be controlled in sequence to maintain the space setpoint temperature. At no time shall the gas fired heat exchanger be operating when the Air Cooled Condensing unit is operating. Whenever the space temperature is above the setpoint, the following shall occur in sequence: The gas control valve shall modulate closed as sequenced below.
  - b. Unoccupied Mode the air cooled condensing units and furnace fans will cycle on to maintain the space temperature setpoint.
  - c. When the discharge air setpoint is below setpoint the reverse shall occur. Air cooled condensing units control shall be locked out below 40° F (adj.) outside air temperature.
4. Gas Fired Heat Exchanger Control: The gas control valve as sequenced under space temperature control. If the space temperature cannot be maintain by the lead furnace heating then stage on a lag furnace heating and modulate gas control valves together to maintain space temperature. If require stage on the third furnace in the same way.

E. SAFETIES:

1. General: All safeties shall be hard wired to the supply. Starters shall not function in the “Hand” or “Auto” shall be disabled if they are indexed to the “Auto” or “Hand” position.

F. Unit Shutdown:

1. Whenever the furnaces are indexed off, the supply fans shall stop. On a failure of a supply fan, an alarm will be sent through the DDC system. Whenever all supply fans are off for any reason the following shall occur:
2. The supply air dampers and the return dampers shall close.
3. The air cooled condensing unit shall be off.
4. The gas control valve(s) shall be off.

G. Unoccupied Control:

1. General: Occupied/unoccupied schedule shall be set at the DDC operator interface. When indexed to unoccupied the unit shall shutdown. Where provided, index DDC controlled heating and cooling terminal units associated with this air handling unit to maintain setback and setup temperature setpoints unless overridden by occupancy sensor or manual pushbutton.
2. Unit Cycling to Maintain Setback/Setup Temperatures: Cycle the air handling unit on to maintain the setback and setup temperature zone setpoints to maintain 58 °F ([adjustable](#)) and 86 °F ([adjustable](#)) respectively. In the heating mode, the outside air and relief air dampers shall close and the return air damper shall open and heating discharge temperature control shall function as specified. In the cooling mode, the discharge temperature control shall be allowed to function as specified. Minimum on runtime timer shall be set for 15 minutes (adj.) and the off timer for 30 minutes (adj.).

### 3.3 CONSTANT VOLUME ENERGY RECOVERY VENTILATOR UNIT CONTROL (ERV-1):

#### A. General:

1. The energy recovery system will provide the make-up air and exhaust air for the building during occupied times only.
2. The Air Handling unit is constant air volume, indoor air unit.
3. The Air Handling unit is controlled by direct digital controller (DDC).
4. The Air Handling unit is equipped with the following:
  - a. Supply fan with starter.
  - b. Exhaust fan with starter.
  - c. Outside air damper furnished by Temperature Control Contractor (TCC). (Refer to specification 23 09 14)
  - d. Return air damper furnished by TCC. (Refer to specification 23 09 14)
  - e. Relief air damper furnished by TCC. (Refer to specification 23 09 14)
  - f. Cross plate energy recovery heat exchanger.
  - g. Filter Bank
  - h. Actuators furnished by TCC. (Refer to specification 23 09 14)

#### B. FAN CONTROL:

1. Start/Stop: The DDC system shall start and stop the supply and exhaust fan. Fans shall operate during occupied times only.
2. Current Status Switch: Provide for both supply and exhaust fans and set up as described under GENERAL, Current Switch Setup, in this Section.

#### C. VENTILATION AIR Control:

1. Minimum Outside Ventilation Air Flow Control: This unit will operate only during occupied times to provide the required ventilation air for the building. The control contractor shall work with the balancing contractor to the minimum scheduled ventilation airflow.

#### D. Filters:

1. Install a differential static pressure sensor across each filter bank. Ensure that the static probes do not impede filter removal.
2. For filter bank, provide an alarm to the operator interface when the differential static pressure exceeds 1.0" W.C (adj.).

#### E. UNIT Shutdown:

1. Whenever the ERV unit is indexed off, the supply and exhaust fans shall stop. If the exhaust fan fails off, the supply fan shall be indexed off. On a failure of either the supply or exhaust fan, an alarm will be sent through the DDC system. Whenever both supply and exhaust fans are off for any reason the following shall occur:
2. The outside air dampers and exhaust air dampers shall close and the return dampers shall open.

#### F. UNOCCUPIED Control:

1. General: Occupied/unoccupied schedule shall be set at the DDC operator interface. When indexed to unoccupied the unit shall shutdown.

### 3.4 TERMINAL UNIT CONTROL – DDC AND ELECTRIC:

#### A. CABINET AND UNIT HEATER CONTROL:

1. Provide an electric space thermostat to maintain space temperature.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 23 11 00 - NATURAL GAS FUEL PIPING

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section contains specifications for natural gas fuel systems for this project. Included are the following requirements:

#### 1.2 RELATED WORK

- A. Section 23 05 00 – Common Work Results for HVAC
- B. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- C. Section 23 55 00 – Fuel Fired Heaters
- D. Section 23 84 13 – Humidifiers

#### 1.3 REFERENCE

- A. Provisions of Division 01 govern work under this section.

#### 1.4 REFERENCE STANDARDS

- A. ANSI B16.3 Malleable Iron Threaded Fittings
- B. ANSI B16.5 Pipe Flanges and Flanged Fittings
- C. ANSI B16.9 Carbon Steel Weld Fittings
- D. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
- E. ASTM A105 Forgings, Carbon Steel, for Piping Components
- F. ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
- G. ASTM A181 Forgings, Carbon Steel for General Purpose Piping
- H. ASTM A197 Cupola Malleable Iron
- I. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- J. ASTM D2513 Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
- K. NFPA 54 ANSI Z223.1 National Fuel Gas Code

#### 1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.

- B. Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM specification.
- C. Installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the project.

#### 1.6 SUBMITTALS

- A. Required for all items in this section.
- B. Submit a schedule of valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for valves to be used on the project. Temperature and pressure ratings specified are for continuous operation.
- C. Include materials of construction, dimensional data, ratings/capacities/ranges, pressure drop data where appropriate, and identification as referenced in this section and as indicated on the drawings.

#### 1.7 DESIGN CRITERIA

- A. Where valves are specified for individual mechanical services all valves shall be of the same manufacturer unless prior written approval is obtained.
- B. Valves and piping specialties are to be rated for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 PSIG at 240°F unless specifically indicated otherwise.

#### 1.8 DELIVERY, STORAGE AND HANDLING

- A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.
- B. Cover pipe to eliminate rust and corrosion while allowing ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

#### 1.9 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
- B. Construct piping systems for not less than 125 psig unless specifically indicated otherwise.
- C. Piping systems shall comply with NFPA 54, latest edition.
- D. Where weld fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.



- E. Steel piping and fittings shall be manufactured in the United States.

#### 1.10 WELDER QUALIFICATIONS

- A. Welding procedures, welders, and welding operators for natural gas piping to be in accordance with certified welding procedures of the National Certified Pipe Welding Bureau.
- B. The Architect or Engineer reserves the right to test and inspect the work of any welder employed on the project, at the Contractor's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

#### 1.11 NATURAL GAS SERVICE

- A. Natural gas service, including the connection from the main in the street or other location to the gas meter and the gas meter will be provided by the local gas utility. Utility installation costs are the responsibility of this contractor. Coordinate with the local gas utility. Gas pressure entering building will be 5 psig.

### PART 2 - PRODUCTS

#### 2.1 NATURAL GAS

- A. 2" and Smaller
  - 1. ASTM A53, type E or S, standard weight (schedule 40) black steel pipe with ASTM A197/ANSI B16.3 class 150 black malleable iron threaded fittings or ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.
- B. 2½" and Larger
  - 1. ASTM A53, type E or S, standard weight black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.

#### 2.2 NATURAL GAS (UNDERGROUND)

- A. ASTM D2513 thermoplastic polyethylene gas pressure pipe with butt-weld or socket-type polyethylene fusion joints and fittings.

#### 2.3 UNDERGROUND PIPE WRAP

- A. Use a flexible polymer film with a coal tar and synthetic elastomeric coating of 36 mil thickness and dielectric strength exceeding 12 KV. Use a compatible primer below the polymer film.

#### 2.4 UNIONS AND FLANGES

- A. 2" and Smaller
  - 1. ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 PSI.

- B. 2½" and Larger
  - 1. ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern and of a pressure class compatible with that specified for valves, piping specialties and fittings of the respective piping service. Flanges smaller than 2½" may be used as needed for connecting to equipment and piping specialties. Use raised face flanges ANSI B16.5 for mating with other raised face flanges on equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment. Gasket material to be non-asbestos and rated for pressures and temperatures of the piping system.

## 2.5 GAS VALVES

- A. Crane, Walworth, Jenkins, Nibco, Milwaukee or Southern Manufacturing Company are acceptable manufacturers.
- B. ½" to 4"
  - 1. Southern Manufacturing Company Fig. 425 gas valve, cast iron body, screwed or flanged ends, bronze bearings, bronze plug and resilient seal ring for drop tight shutoff to 175 PSIG working pressure.
- C. 5" to 6"
  - 1. Southern Manufacturing Company Fig. 118 cast iron body, eccentric plug, flanged ends, stainless steel bearings, resilient faced plug for drop tight shutoff to 175 PSIG working pressure.

## 2.6 GAS PRESSURE REGULATORS

- A. Fisher or Kunkle are acceptable manufacturers.
- B. Regulators shall reduce 5 PSIG line pressure to 14" water column, unless noted otherwise on the plans.
- C. ¾" to 1¼"
  - 1. Fisher S100 Series, self-operated regulation with cast iron body, relief, spring steel case and Nitrile diaphragm.
- D. 1½" to 2"
  - 1. Fisher S200 Series, self-operated regulation with cast iron body, relief, spring steel case and Nitrile diaphragm.

## 2.7 GAS PRESSURE GAUGES

- A. Kunkle, Taylor or Taylor are acceptable manufacturers.
- B. Trerice No. 860 with 3½ face, stainless steel case, bronze bushing movement, white background and black figures. Graduated from 0 to \_\_\_\_ PSIG on the high pressure side and 0" to 15" water column on the low pressure side.
 

|                            |                               |
|----------------------------|-------------------------------|
| <i>Scale Range (In WC)</i> | <i>Minor Division (In WC)</i> |
| 0 – 15                     | 0.1                           |

## PART 3 - EXECUTION

### 3.1 ERECTION

- A. Remove all foreign material from interior and exterior of pipe and fittings.
- B. Install piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping to clear interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- C. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.
- D. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half ( $\frac{1}{2}$ ) the diameter of the main.
- E. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.
- F. Install valves and piping specialties, including items furnished by other sections of work, as specified and detailed. Make connections to equipment installed by other sections of work where that equipment requires the piping services indicated in this section.
- G. Piping and equipment is to be installed according to the latest utility requirements, NFPA 54, and local codes.
- H. Pitch horizontal piping down 1" in 60 feet in the direction of flow. Install a 4" minimum depth dirt leg at the bottom of each vertical run and at each appliance. When installing mains and branches, cap gas tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main.
- I. Do not install gas pipe below a building or its foundation.
- J. Piping through the roof shall be run through specified roof penetration with flashing and counter flashing.
- K. Exposed gas piping (exposed piping outside and exposed piping inside the building) shall be painted after installation with a compatible metal primer coat and a finish coat of yellow paint compatible for the application. Gas piping shall be clearly identified with pipe markings as specified under section 15050B.
- L. Joints in underground polyethylene gas pipe must be made by qualified personnel proficient in the joining methods of ASTM D2513 thermoplastic gas pressure pipe and polyethylene fittings. Do not install polyethylene gas pipe inside buildings or above ground.
- M. Make all transitions from polyethelyne gas piping to steel piping so that the joint is 2 feet below grade.

- N. Provide a 12 gauge (minimum) insulated copper tracer wire running along with the underground gas piping. Underground connections shall be made with encapsulating insulators.
- O. Provide yellow warning tape located 1 foot above the pipe. Warning tape is to identify the type of piping below.

### 3.2 WELDED PIPE JOINTS

- A. Welded joints shall be constructed by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable.
- B. Electrodes shall be Lincoln with coating and diameter as recommended by the manufacturer for the type and thickness of work being done.

### 3.3 THREADED PIPE JOINTS

- A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking shall be used.

### 3.4 UNDERGROUND PIPE WRAP

- A. Use for underground metallic piping which is not encased in a conduit and for underground metallic gas conduit.
- B. Remove all dirt and other foreign material from exterior of pipe. Apply primer as recommended by the manufacturer. Use a spiral wrap process for applying tape to the pipe. Repair any breaks in the tape coating caused by the installation process.

### 3.5 UNIONS AND FLANGES

- A. Install a union or flange at each piping specialty or piece of equipment which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

### 3.6 PIPING SYSTEM LEAK TESTS

- A. Verify that the piping system being tested is fully connected to components and that equipment is properly installed, wired, and ready for operation. Verify that hangers can withstand the additional weight load that may be imposed by the test.
- B. Conduct pressure test with test medium of air to 100 psig. Minimum test time of 24 hours; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by the Architect or Engineer. Notify the above parties 72 hours prior to pipe system testing. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.
- C. Gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine joints and connections with a soap bubble solution or equivalent method. The piping system shall show no evidence of leaking.
- D. Measure natural gas system test pressure with a manometer or with a pressure measuring device designed to read, record or indicate a pressure loss in the piping

system due to leakage during the pressure test period. The test medium shall be air, Nitrogen, or carbon dioxide. OXYGEN OR FUEL GAS SHALL NOT BE USED.

- E. The pressure measuring device shall be calibrated in increments not greater than 0.5 PSIG having an accuracy of not less than 1% over the entire range of the pressure measuring device. A Trerice No. 450 gauge, 0-60 PSI range meets these requirements. The piping system shall show no pressure loss. Any pressure drop shall be deemed to indicate the presence of a leak unless the reduction can be attributed to some other cause. Systems will not be accepted until it can be demonstrated that there is no measurable loss of test pressure during the test period.
- F. Testing shall conform to the requirements of NFPA Chapter 54, latest edition.

### 3.7 GAS VALVES

- A. Install a line size gas valve and union at each gas appliance connection, and as shown on the drawings.
- B. Provide a valved connection at the main for equipment and appliances furnished by other sections of work.

### 3.8 GAS PRESSURE REGULATORS

- A. Install gas regulators as shown on the drawings per the manufacturer's installation instructions.
- B. Each gas pressure regulator/reducing valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according code requirements and gas utility regulations.
- C. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least five feet above grade.

### 3.9 GAS PRESSURE GAUGES

- A. Install gas pressure gauges as shown on the drawings so that the face is readable by a person standing at floor level.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 23 23 00 - REFRIGERANT PIPING

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section contains specifications for refrigerant pipe and pipe fittings for this project.

#### 1.2 RELATED WORK

- A. Section 23 05 00 – Common Work Results for HVAC
- B. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- C. Section 23 07 00 – HVAC Insulation

#### 1.3 REFERENCE

- A. Provisions of Division 01 govern work under this section.

#### 1.4 REFERENCE STANDARDS

- A. ASTM B280 Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

#### 1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.
- B. Order copper refrigeration tube with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier; with soft straight lengths or coils identified with a tag indicating that the product was manufactured in accordance with ASTM B280; and with each hard temper straight length identified throughout its length by a blue colored marking not less than 3/16 inch in height and a legend at intervals of not greater than three feet that includes the designation "ACR" and pipe outside diameter.
- C. Installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the project.

#### 1.6 DELIVERY, STORAGE AND HANDLING

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

- C. Offsite storage agreements does not relieve the Contractor from using proper storage techniques.

## 1.7 DESIGN CRITERIA

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

## PART 2 - PRODUCTS

### 2.1 REFRIGERANT PIPING

- A. Provide factory furnished refrigerant tubing sets with the air conditioning units as specified in other sections of this specification.

### 2.2 VENTS AND RELIEF VALVES

- A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

### 2.3 REFRIGERANT SPECIALTIES

#### A. FILTER DRYERS

- 1. For circuits 15 tons and over provide angle pattern filter dryers with replaceable core. For circuits below 15 tons provide straight pattern filter dryers without replaceable core.

#### B. SIGHT GLASSES

- 1. Two piece brass construction with solder end connections. Include color indicator for sensing moisture.

#### C. SOLENOID VALVES

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

#### D. HOT GAS BYPASS VALVES

- 1. Provide with integral solenoid valve, external equalizer connection and adjustable pilot assembly.

#### E. THERMOSTATIC EXPANSION VALVES

- 1. Brass body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

#### F. CHARGING VALVES

- 1. Provide 1/4" SAE brass male flare access ports with finger tight, quick seal caps. Provide 2-inch long copper extension sections.

#### G. CHECK VALVES

- 1. Spring loaded type with bronze body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.



## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Remove foreign material from interior and exterior of pipe and fittings.

### 3.2 ERECTION

- A. Install piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping to clear interferences. Consult the plans for the location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Mitered ells and notched tees are not acceptable.
- C. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.
- D. Install valves and piping specialties, including items furnished by other sections of work, as specified and as detailed. Make connections to equipment installed by other sections of work where that equipment requires the piping services indicated in this section.
- E. Remove slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with emery cloth or sandpaper. Remove residue from the cleaning operation and assemble joint.
- F. Solder joints shall be ASTM Grade 4 or 5 and have a melting point of approximately 1250 degrees F. Solder impurities shall not exceed 0.15%. Tubing to be new and delivered to the job site with the original mill end caps in place. Clean and polish joints before soldering. Avoid prolonged heating and burning during soldering. Purge lines with nitrogen during soldering. Provide manual shut-off and check valves to permit system servicing.
- G. No refrigerant is to be vented directly to the atmosphere except that which may escape through leaks in the system during leak testing. During evacuation procedures, use equipment designed to recover and allow recycling of the refrigerant.
- H. Refrigeration piping to be installed by firms who are experienced in installation of refrigerant piping.
- I. Refrigeration piping shall be installed in accordance with the requirements of the Wisconsin Administrative Code Section COMM 45.

### 3.3 VENTS AND RELIEF VALVES

- A. Install vent and relief valve discharge lines as specified on the drawings, as detailed, and as specified for each specific valve or piping specialty item. In no event is a termination to occur less than six feet above a roofline.

### 3.4 PIPING SYSTEM LEAK TEST

- A. Verify that the piping system being tested is fully connected to system components and that equipment is properly installed, wired, and ready for operation.
- B. Leak test the system by charging the system to a pressure of 10 psig with an HFC refrigerant, with the compressor suction and discharge valves closed and with all other system valves open. Increase pressure to 300 PSIG with dry nitrogen. Rap joints with a mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one ounce per year. Seal leaks and retest.
- C. After completion of the leak test, evacuate the system with a vacuum pump to an absolute pressure not exceeding 1500 microns while the system ambient temperature is above 60°F. Break the vacuum to 2 PSIG with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Install a drier of the required size in the liquid line, open the compressor suction and discharge valves, and evacuate to an absolute pressure not exceeding 500 microns. Leave the vacuum pump running for not less than two hours without interruption. Raise the system pressure to 2 PSIG with refrigerant and remove the vacuum pump.
- D. Charge refrigerant directly from original containers through a combination filter-drier. Each drier may be used for a maximum of three cylinders of refrigerant and then must be replaced with a fresh drier. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.
- E. Do not insulate pipe until it has been successfully tested.

END OF SECTION

## SECTION 23 31 00 - HVAC DUCTS AND CASINGS

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes specifications for duct systems used on this project. Included are the following requirements:

#### 1.2 RELATED WORK

- A. Section 23 05 00 – Common Work Results for HVAC
- B. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- C. Section 23 33 00 – Air Duct Accessories
- D. Section 23 05 93 – Sequence of Operation for HVAC Controls

#### 1.3 REFERENCE

- A. Provisions of Division 01 govern work under this Section.

#### 1.4 REFERENCE STANDARDS

- A. ANSI/ASTM B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- B. ASTM A90 Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
- C. ASTM A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- D. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- E. ASTM C 1071 Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
- F. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems
- G. UL 181

#### 1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.

#### 1.6 SUBMITTALS

- A. Include manufacturer's data and Contractor data for the following:
  - 1. Duct sealant and gasket material.
  - 2. Duct liner including data on thermal conductivity, air friction correction factor, and limitation on temperature and velocity.

## 1.7 DESIGN CRITERIA

- A. Construct ductwork to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions.
- B. Use material, weight, thickness, gauge, construction and installation methods as outlined in the latest editions of the following SMACNA publications, unless noted otherwise:
  - 1. HVAC Duct Construction Standards, Metal and Flexible
  - 2. HVAC Air Duct Leakage Test Manual,
  - 3. HVAC Systems - Duct Design
- C. Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Aluminum sheet metal used for construction of duct shall be 22 gauge or heavier.
- B. Spiral round ductwork 12" diameter and less shall be 26 gauge or heavier.
- C. Other sheet metal used for construction of duct shall be 24 gauge or heavier.
- D. Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net, inside of liner.
- E. Duct system pressure classes shall be according to the following schedule:

#### F-1, F-2 and F-3

##### RECTANGULAR DUCTS

| Duct type/location | Pressure class  | Duct Construction | Inner Wall | Lining |
|--------------------|-----------------|-------------------|------------|--------|
| Supply duct mains  | 2 inch positive | Single wall       | None.      | No     |
| Return ducts       | 2 inch negative | Single wall       | None       | No     |

##### ROUND DUCTS

| Duct type/location | Pressure class  | Duct Construction | Inner Wall | Lining |
|--------------------|-----------------|-------------------|------------|--------|
| Supply duct mains  | 2 inch positive | Single wall       | None       | No     |

##### GENERAL

| Duct type/location  | Duct Shape  | Pressure class  | Duct Construction | Lining |
|---------------------|-------------|-----------------|-------------------|--------|
| Relief ducts        | Rectangular | 2 inch negative | Single wall       | Yes/No |
| Transfer ducts      | Rectangular | ½ inch positive | Single wall       | Yes/No |
| Exhaust ducts       | Rectangular | 2 inch negative | Single wall       | None   |
| Exhaust ducts       | Round       | 2 inch negative | Single wall       | None   |
| Heat Recovery ducts | Round       | 2 inch          | Single wall       | None   |

### 2.2 MATERIALS

- A. GALVANIZED STEEL SHEET
  - 1. Use ASTM A924 (Formerly ASTM A525) or ASTM A653 (Formerly ASTM A527) galvanized steel sheet of lock forming quality. Galvanized coating to be

1.25 ounces per square foot, both sides of sheet, G90 in accordance with ASTM A90.

## 2.3 FLEXIBLE DUCT

### A. Manufacturers

1. Clevaflex, Thermaflex, Wiremold or Flexmaster.
2. Factory fabricated, UL 181 listed as a class 1 duct, and having a flame spread of 25 or less and a smoke developed rating of 50 or under in accordance with NFPA 90A.
3. Rated for pressures and temperatures involved but not less than a 180°F service temperature and  $\pm 6$  inch pressure class.
4. Duct to be composed of polyester film, aluminum laminate or woven and coated fiberglass fabric bonded permanently to corrosion resistant coated steel wire helix. Two-ply, laminated, and corrugated aluminum construction may also be used.
5. Where duct is specified to be insulated, provide a minimum 1-inch fiberglass insulation blanket with maximum thermal conductance of 0.23 K (75 degrees F.) and vapor barrier jacket of polyethylene or metalized reinforced film laminate. Maximum perm rating of vapor barrier jacket to be 0.1 perm.

## 2.4 LOW PRESSURE DUCTWORK (MAXIMUM 3 INCH PRESSURE CLASS)

### A. GENERAL

1. Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as modified below.
2. Construct so that interior surfaces are smooth. Use riveted or bolted construction when fabricating ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if the screw does not extend more than  $\frac{1}{2}$  inch into the duct.
3. Use elbows and tees with a center line radius to width or diameter ratio of 1.0 wherever space permits. When a short radius (less than 1.0 ratio) elbow must be used due to limited space, install single wall sheet metal turning vanes in accordance with Section 23 33 00. Where space does not allow, and the C value of the radius elbow, as given in SMACNA publications, exceeds 0.31, use rectangular elbows with turning vanes as specified in Section 23 33 00. Square throat-radius heel elbows is not acceptable.
4. Where rectangular elbows are used, provide turning vanes in accordance with Section 23 33 00.
5. Provide expanded take-offs for branch duct connections or 45-degree entry fittings. Square edge 90-degree take-off fittings or straight taps is not acceptable.
6. Round ducts may be substituted for rectangular ducts if sized in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission of the Architect/Engineer.
7. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

### B. SINGLE WALL ROUND AND OVAL

1. Manufacturers
  - a. Ajax, Semco, Lindab or United Sheet Metal.

- b. Machine formed round and flat oval spiral lock seam duct constructed of G-90 galvanized steel.
- c. Contractor fabricated spiral round ductwork meeting specified construction standards is acceptable with prior approval of Architect/Engineer. Submit construction details, a description of materials to be used, type of service, reinforcing methods, and sealing procedures.

## 2.5 DUCT SEALANT

- A. Manufacturer
  - 1. 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Lockformer cold sealant, Mon-Eco Industries, or United Sheet Metal.
  - 2. Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup of air handling systems.

## 2.6 GASKETS

- A. 3 INCH PRESSURE CLASS AND LOWER
  - 1. Soft neoprene gaskets in combination with duct sealant for flanged joints.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Verify dimensions at the site, making field measurements and drawings necessary for fabrication and erection. Check plans showing work of other trades and consult with Architect in the event of any interference.
- B. Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Transform, divide or offset ducts to fit the installation, in accordance with SMACNA HVAC Duct Construction Standards, Figure 2-10, Fig. C, except do not reduce duct to less than six inches in either dimension and do not exceed an 8:1 aspect ratio. Where it is necessary to take pipes or similar obstructions through ducts, construct easement as specified in SMACNA HVAC Duct Construction Standards, Figure 2-10, Fig. E. In all cases, seal to prevent air leakage. Pipes or similar obstructions may not pass through high pressure or fume exhaust ductwork.
- C. Cut or drill temporary test holes in ducts for all testing required. Cap with neoprene plugs, threaded plugs, or threaded or twist-on metal caps. Test openings for test and balance work will be provided under Section 23 05 93.
- D. Provide frames constructed of angles or channels for coils, filters, dampers or other devices installed in duct systems, and make connections to equipment including equipment furnished by other sections of work. Secure frames with gaskets and screws or nut, bolts and washers.
- E. Install duct to pitch toward outside air intakes to outside of building. Solder or seal seams to form watertight joints in outside air intake ducts.
- F. Where two different metal ducts meet, the joint shall be installed in a manner that metal ducts do not contact each other by using proper seal or compound.

- G. Install motor operated dampers and connect to, or install equipment furnished by other sections of work.
- H. Blank off unused portions of louvers with 1½ inch board insulation with galvanized sheet metal backing on both sides.
- I. Do not install ductwork through dedicated electrical rooms or spaces unless the ductwork is serving this room or space.
- J. Locate ducts with space around equipment to allow normal operating and maintenance activities.
- K. Connect terminal units to mains with flexible duct no longer than the lesser of three duct diameters or five feet. Do not use flexible duct to change direction.
- L. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Protect ductwork against entry of foreign matter during construction.
- M. Use double nuts and lock washers on threaded rod supports for ducts.
- N. Remove dirt and foreign matter from the entire duct system and clean diffusers, registers and grilles before operating fans.
- O. Provide temporary capping of ductwork to prevent entry of foreign matter during construction.
- P. When appropriate, metallic foil backed duct tape may be used to seal duct seams and joints. Under no circumstances shall “typical” cloth duct tape be used for sealing ductwork, or for any other purpose.
- Q. Install turning vanes in rectangular, mitered elbows in accordance with SMACNA standards. Follow turning vane manufacturer's recommendations for installation.
- R. Support ductwork from the building construction in accordance with SMACNA standards and guidelines. Refer to Section 23 05 29 for anchors and supports required to suspend ductwork from concrete structures and steel structural members.
- S. For ductwork running through joists or trusses, do not support ductwork by laying on the bottom chord. Hang ductwork from the top chord of the truss or joist.
- T. Wire hangers shall only be used for rounds ducts 12 inches or less in diameter. Rectangular ducts and larger diameter round ducts shall be supported with strap hangers or steel shapes or uni-strut supports in accordance with SMACNA standards.

### 3.2 FLEXIBLE DUCT

- A. Flexible duct may be used for final connection of air outlets, diffusers and grilles. Where flexible duct branch run-out is perpendicular to the air outlet connection, provide a sheetmetal elbow at the connection to the air outlet to facilitate connection of the flexible duct. Where flexible duct is used, it shall be the minimum length required to make the final connections, but no greater than [5] [10 feet in length with support spacing not exceeding every 4 feet].

- B. Secure flexible ducts to the rigid branch duct with stainless steel draw bands. The use of sheetmetal screws or duct tape to attached flexible ducts to hard ducts is not acceptable.
- C. Flexible duct used to compensate for misalignment of main duct or branch duct is not acceptable.
- D. Flexible ductwork is not acceptable in mechanical chases or in exposed locations.
- E. Individual sections of flexible ductwork shall be of one-piece construction. Splicing of short sections is not acceptable.
- F. Penetration of partitions, walls, or floors with flexible duct is not acceptable.
- G. The use of flexible ductwork for connecting branch ducts to exhaust and return grilles is not acceptable.

### 3.3 LOW PRESSURE DUCTWORK (MAXIMUM 3 INCH PRESSURE CLASS)

- A. Seal ductwork in accordance with SMACNA seal class "B". All seams, joints, and penetrations shall be sealed.
- B. Install a manual balancing damper in each branch duct and for each diffuser or grille. The use of splitter dampers, extractors, or grille face dampers is not acceptable as use as a balancing dampers.
- C. Hangers must be wrapped around bottom edge of duct and securely fastened to duct with sheetmetal screws or pop rivets. Trapeze hangers may be used at Contractor's option.

END OF SECTION



## SECTION 23 33 00 - AIR DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes accessories used in the installation of duct systems. Included are the following requirements:

#### 1.2 RELATED WORK

- A. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- B. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment

#### 1.3 REFERENCE

- A. Provisions of Division 01 govern work under this Section.

#### 1.4 REFERENCE STANDARDS

- A. NFPA 90A      Standard for Installation of Air Conditioning and Ventilating Systems
- B. SMACNA      HVAC Duct Construction Standards - Metal and Flexible, First Edition, 1985
- C. UL 214
- D. UL 555      Standard for Fire Dampers and Ceiling Dampers
- E. UL 555S      Leakage Rated Dampers for Use in Smoke Control Systems

#### 1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.

#### 1.6 SUBMITTALS

- A. Submit for ductwork accessories specified under this section. Include dimensions, capacities, ratings, installation instructions, and appropriate identification.
- B. Include certified test data on dynamic insertion loss, self-noise power levels, pressure losses, and aerodynamic performance of each sound attenuator at its specified conditions.
- C. Submit manufacturer's color charts where finish color is specified to be selected by the Architect/Engineer.
- D. Fire damper, smoke damper and control damper submittals shall include free area data, certified pressure drop data and air leakage data for the actual damper sizes used.

## PART 2 - PRODUCTS

### 2.1 MANUAL VOLUME DAMPERS

#### A. Manufacturers

1. Air Balance, Kees, Nailor, Ruskin, or Vent Products.
2. Dampers must be constructed in accordance with SMACNA Fig. 2-12 and Fig. 2-13, and notes relating to these figures, except as modified below.
3. Reinforce blades to prevent vibration, flutter, or other noise. Construct dampers in multiple sections with mullions where width is over 48 inches. Use rivets or tack welds to secure individual components; sheet metal screws will not be accepted. Provide operators with locking devices and damper position indicators for each damper; use an elevated platform on insulated ducts. Provide end bearings or bushings for all volume damper rods penetrating ductwork constructed to a 3" W.C. pressure class or above.

### 2.2 TURNING VANES

#### A. Manufacturers

1. Aero Dyne, Anemostat, Barber-Colman or Hart & Cooley.
2. Construct turning vanes and runners for square elbows in accordance with SMACNA Fig. 2-3 and Fig. 2-4 except use only airfoil type vanes. Construct turning vanes for short radius elbows and elbows where one dimension changes in the turn in accordance with SMACNA Fig. 2-2 and Fig. 2-5.

### 2.3 MOTORIZED BACKDRAFT DAMPERS

- #### A.
- Refer to fan, air handling unit or temperature control specifications as applicable for damper specifications.

### 2.4 GRAVITY BACKDRAFT DAMPERS

#### A. Manufacturers

1. Ruskin model CBD4 or equivalent Air Balance, Advanced Air, Cesco, American Warming and Ventilating, Vent Products Company Inc., Greenheck or Arrow.
2. Dampers shall be adjustable type, counterbalanced, self-acting, multiple bladed backdraft air dampers of sizes indicated or required.
3. Dampers shall begin to open in the desired direction of airflow when the upstream to downstream differential static pressure reaches approximately 0.05 to 0.10 inches of water column.
4. Blades shall be constructed of 0.070" thickness aluminum with a 6" maximum blade width, interlocking neoprene or extruded vinyl blade edge seals, dust proof ball bearing shaft supports, interconnecting linkage and adjustable counterbalancing weights.
5. Frame shall be constructed of 0.081 thickness extruded aluminum.

### 2.5 FIRE DAMPERS

#### A. Manufacturers

1. Greenheck, Ruskin, Air Balance, Advanced Air, American Warming and Ventilating, Cesco, Nailor, National Control Air, Safe-Air, Phillips-Aire, or Prefco.
2. Fire damper assemblies shall be UL 555 listed and labeled for the application and meet requirements of NFPA 90A. Dampers shall be type B. Damper blades must

be 100% out of air stream; dampers with blades in the air stream will not be accepted. Damper fire rating to be compatible with the rating of the building surface in which the damper is used.

3. Use ceiling fire dampers that are designed for use in floor or roof/ceiling assemblies in which they are to be installed.
4. Provide closure springs and latches for horizontal damper installations.
5. Fire dampers installed in stainless steel or aluminum duct systems shall be constructed of stainless steel.
6. Factory provided integral damper sleeves are not acceptable.
7. Provide pressure drop information as part of the damper submittal.

## 2.6 SMOKE DAMPERS AND COMBINATION FIRE/SMOKE DAMPERS

### A. Manufacturers

1. Greenheck, Ruskin, Johnson Controls, Air Balance, Advanced Air, American Warming and Ventilating, Safe-Air or Prefco.
2. Smoke dampers and combination smoke/fire dampers shall be UL listed as an assembly, including the damper, framing and damper actuator.
3. Minimum smoke damper size allowed is 12" X 12". Air pressure drop of damper shall not exceed 0.15" W.G. at design duct velocity. Damper free area shall be a minimum of 90% of the duct in which it is installed, for all size dampers, taking the damper internal framing into account.
4. The use of extended blade stops to compensate for blade dimensions that do not match the desired damper frame size will not be accepted. Dampers shall be provided with "cut-off" blades or blade extensions which maximize the free area of the damper.
5. Smoke dampers to be leakage rated at no higher than Class II under UL 555S. Leakage shall not exceed 10 CFM/square foot at 1" water gauge, and 20 CFM/square foot at 4" water gauge.
6. Combination fire/smoke dampers to be UL 555 listed, have a fire rating compatible with the rating of the building surface in which the damper is used, and be leakage rated at no higher than Class II under UL 555S. Leakage shall not exceed 10 CFM/square foot at 1" water gauge, and 20 CFM/square foot at 4" water gauge.
7. Use pneumatically operated dampers with linkage and UL listed operators arranged so that the damper is closed on loss of pneumatic air pressure. Locate all operators out of the air stream. Provide end switches to indicate damper position.
8. Use electrically operated dampers with linkage and UL listed operators arranged so that the damper is closed on loss of electrical power. Locate all operators out of the air stream. Provide end switches to indicate damper position.
9. Use airfoil shaped damper blades on the following systems:

## 2.7 CONTROL DAMPERS

- A. Control dampers are specified under section 23 09 23 .Refer to the temperature control sections as applicable for damper specifications on this project. Refer to fan and air handling unit sections of the specifications for additional dampers specified under those sections.

## 2.8 ACCESS DOORS

### A. Manufacturers

1. SMACNA Standard access doors as manufactured by Greenheck, Ruskin, Air Balance, Advanced Air, American Warming and Ventilating, Vent Products Company Inc., or Arrow.
2. Access doors shall be constructed in accordance with SMACNA Fig. 2-10 and Fig. 2-11, and notes relating to these figures, except as modified below.
3. Construction to be rated for the pressure class of the duct in which the door is to be installed. Materials of construction to be identical to adjacent ductwork. Doors in exposed areas shall be hinged type with sash lock. Doors in concealed spaces may be secured in place with cam latches. Gasket all access doors. Use insulated doors when installed in insulated ductwork. Access doors constructed with sheet metal screw fasteners will not be accepted.
4. Use insulated, 1½ hour UL 555 listed and labeled access doors in kitchen exhaust ducts.

## 2.9 DUCT FLEXIBLE CONNECTIONS

- A. Material to be fire retardant, be UL 214 listed, and meet the requirements of NFPA 90A.
- B. Connections to be a minimum of 3 inches wide, crimped into metal edging strip, and air tight. Connections to have adequate flexibility and width to allow for thermal expansion/contraction, vibration of connected equipment, and other movement.
- C. Use coated glass fiber fabric for all applications. Material for inside applications other than corrosive environments, fume exhaust, or kitchen exhaust to be double coated with neoprene, air and water tight, rated for temperatures between -10° □F and 200° □F, and have a nominal weight of 30 ounces per square yard. Material used for outdoor applications other than corrosive environments, fume exhaust, or kitchen exhaust to be double coated with Hypalon, air and water tight, rated for temperatures between -10° □F and 250° □F, and have a nominal weight of 26 ounces per square yard.
- D. For corrosive environments or fume exhaust applications indoors or outdoors, use a material coated with Teflon that is air and water tight, rated for temperatures between -20° □F and 500° □F, and has a nominal weight of 14 ounces per square yard.

## 2.10 LOUVERS

- A. Louvers shall be provided by this section of work.
- B. Manufacturers
  1. Greenheck, Ruskin, Vent Products Company Inc., Airolite, Industrial Louvers, Cesco, American Warming and Ventilating, Louvers and Dampers, Arrow or Construction Specialties.
  2. Drainable blade louver constructed of extruded aluminum alloy having not less than 12 gauge (.08") thickness frame and blades, all-welded assembly 45 degree blade angle. Overall depth of louver shall be 4 inches thick. Provide with maximum 1/2 inch square aluminum bird screen having a 12 gauge aluminum frame.
  3. Louver to bear the AMCA certified ratings seal for both air performance and water penetration, having a free area not less than 50% based on a 48" x 48" section, water penetration no greater than 0.01 oz/square foot under AMCA test at 1000 feet per minute and an intake pressure drop less than 0.20 inches of water at 1000 feet per minute.

4. Louver finish shall be baked enamel (Fluoropolymer) custom color. Color shall be selected by the Architect. Furnish louver with additional paint in the same color as the louver to paint the outer surface of panels over unused portions of louvers and to paint the interior portion of ductwork visible through the louvers.

## 2.11 DUCT THERMOMETERS

### A. MANUFACTURERS

1. Ashcroft, Marsh, Taylor, H.O. Trerice, U.S. Gauge, Weiss, Weksler.

### B. DESCRIPTION

1. Equivalent to Trerice Industrial Thermometer, insertion stem type, with black finish cast aluminum case, 9 inch scale, clear acrylic window, reversible aluminum mounting flange, perforated aluminum sensor guard, adjustable angle brass stem with stem length adequate so the end of the stem is near the middle of the duct, red indicating fluid and black lettering against a white background having a minimum increment of 2° F. Scale ranges shall be as follows:

| Service           | Scale Range, °F |
|-------------------|-----------------|
| Outside air ducts | -40 - 110       |
| Mixed air ducts   | -40 - 110       |
| Return air ducts  | 30 - 130        |
| Supply air ducts  | 30 - 180        |

## PART 3 - EXECUTION

### 3.1 MANUAL VOLUME DAMPERS

- A. Install manual volume dampers in each branch duct and for each grille, register, or diffuser as far away from the outlet as possible while still maintaining accessibility to the damper. Install so there is no flutter or vibration of the damper blade(s).
- B. Splitter dampers shall not be used in place of volume dampers. Splitter dampers are not allowed on any duct system.

### 3.2 TURNING VANES

- A. Install turning vanes in all rectangular, mitered elbows in accordance with SMACNA standards and manufacturer's recommendations.
- B. Install double wall, airfoil, 2 inch radius vanes in ducts with vane runner length 18" or greater and air velocity less than 2000 fpm. Install double wall, airfoil, 4½ inch radius vanes in ducts with vane runner length 18" or greater and air velocity 2000 fpm or greater.
- C. If duct size changes in a mitered elbow, use single wall type vanes with a trailing edge extension. If duct size changes in a radius elbow or if short radius elbows must be used, install sheetmetal turning vanes in accordance with SMACNA Figure 2-5 and Figure 2-6.

### 3.3 CONTROL DAMPERS

- A. Install dampers at locations indicated on plans. Locate dampers as close to louver as possible. Provide a duct access door for service.

### 3.4 GRAVITY BACKDRAFT DAMPERS

- A. Install dampers at locations indicated on plans. Provide a duct access door for service and access to the counterbalancing weight for inspection and adjustment.

### 3.5 FIRE DAMPERS

- A. Install dampers in strict accordance with manufacturer's installation instructions. Install damper sleeves with retaining angles on both sides of rated partition. Connections of ductwork to fire damper assemblies to be as specified on the installation instructions. Where it is necessary to set dampers out from the rated wall, install a sleeve extension encased in two hour rated fire proofing insulation. Install an access door at each fire damper, located to permit resetting the damper replacing the fusible link.
- B. Manually test each fire damper for proper operation by removing the fusible link. Repair or replace all fire dampers that do not close completely. Re-install fusible link after test.
- C. Fire dampers are not permitted in laboratory hood fume exhaust duct applications.
- D. Identify all fire and smoke dampers. Dampers shall be permanently identified on the exterior of the duct with a label (or painted) having a minimum letter height of 1". Identification shall read either: "FIRE DAMPER", "SMOKE DAMPER" or "FIRE/SMOKE DAMPER".

### 3.6 SMOKE DAMPERS AND COMBINATION FIRE/SMOKE DAMPERS

- A. Install smoke dampers in locations indicated on the drawings in accordance with the manufacturer's instructions. Install an access door adjacent to each damper for inspection and cleaning. Coordinate damper linkage with operators so the dampers are closed when the air system is not operating.
- B. Install combination fire/smoke dampers as specified above for fire dampers. Coordinate damper linkage with operators so the dampers are closed when the air system is not operating.
- C. Minimum smoke damper size allowed is 12" x 12". When a duct size smaller than 12" x 12" is indicated on the plans, provide duct transitions from the listed duct size to match the damper size. Angle of expansion/contraction in duct transition shall not exceed 30°.

### 3.7 CONTROL DAMPERS

- A. Install dampers in locations indicated on the drawings, as detailed, and according to the manufacturer's instructions. Install blank-off plates or transitions where required for proper mixing of air streams in mixing plenums. Provide adequate operating clearance and access to the operator. Install an access door adjacent to each control damper for inspection and maintenance access to the damper and damper operator.

### 3.8 SMOKE DETECTORS

- A. Install duct detector sampling tube at each location indicated. Provide an access door at each smoke detector location for inspection and service access.

### 3.9 ACCESS DOORS

- A. Install access doors where specified, indicated on the drawings, and in locations where maintenance, service, cleaning or inspection is required. Examples include, but are not limited to motorized dampers, fire and smoke dampers, smoke detectors, fan bearings, heating and cooling coils, filters, valves, air flow measuring stations, and control devices needing periodic maintenance.
- B. Provide duct access doors to be to perform the intended service. Minimum access door size shall be 8" x 8" inch size for hand access, 18" x 18" inch size for shoulder access, or other size as specified. Provide access doors on inlet side of reheat coils as well as on both sides of other duct mounted coils.

### 3.10 DUCT FLEXIBLE CONNECTIONS

- A. Install at all duct connections to rotating or vibrating equipment, including air handling units, fans, or other motorized equipment. Physical connection to equipment shall be made in accordance with SMACNA Figure for flexible duct connections. Install thrust restraints to prevent excess strain on duct flexible connections at fan inlets and outlets; see Related Work.
- B. For applications in corrosive environments or fume exhaust systems, use a double layer of the Teflon coated fabric when making the connector.

### 3.11 LOUVERS

- A. Furnish louvers to other sections of work for mounting in exterior walls. Connect outside air intake duct to the louver, sealing all connections air and watertight.
- B. Furnish wall opening locations and dimensions to other trades of work requiring wall opening information.
- C. Provide bird screen on inside of active louver areas. Where louvers are equipped with birdscreens, remove screens at locations where duct connections are not made.
- D. Coordinate louver frame type, and installation requirements with the Architect. Verify wall construction types prior to ordering louvers.
- E. Install insulated metal panel on unused portions of louver. Panels must be sealed weathertight to louver assembly with flashing for proper drainage to outside of building. Paint outside surface of panel to match louver prior to installation. Where ductwork is visible through louver when viewed from outside the building, paint inside of duct to match louver color.

### 3.12 DUCT THERMOMETERS

- A. Install in air ducts where indicated on the drawings or as specified.
- B. Install in strict accordance with manufacturer's recommendations. When installing thermometers directly on insulated ductwork, provide a 1/2" thick piece of elastomeric insulation between the thermometer and the ductwork.
- C. Securely mount to the ductwork. Install so that the thermometer measures a uniform sample of air. Adjust readout so it is readily visible from a standing position on the floor.

END OF SECTION



## SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes specifications for air devices, which includes grilles, registers, ceiling diffusers and slot diffusers used on this project. Included are the following requirements:

#### 1.2 RELATED WORK

- A. Section \_\_\_\_\_ - Security Screws, for Security
- B. Section 23 31 00 – HVAC Ducts and Casings
- C. Section 23 33 00 – Air Duct Accessories

#### 1.3 REFERENCE

- A. Provisions of Division 01 shall govern work under this section.

#### 1.4 REFERENCE STANDARDS

- A. ISO Standard 5219 and 3741
- B. ADC Test Code 1062 GRD84
- C. ASHRAE

#### 1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.

#### 1.6 SUBMITTALS

- A. Include sizes, air flow quantities, types, appropriate identification, locations, quantities, materials of construction, performance ratings, accessories, finishes and appropriate frame styles for the various mountings.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. Grilles, registers and diffusers shall be provided with the appropriate frames compatible with ceiling types. Coordinate ceiling types with other trades.
- B. Registers shall be provided with opposed blade manual volume dampers.
- C. Finishes are specified within. Verify finishes with the Architect prior to ordering grilles. Submit color charts for custom finishes where applicable.

## 2.2 MANUFACTURERS

- A. Titus, Carnes, Krueger, Metalaire, Nailor, Price or Tuttle & Bailey.

## 2.3 GRILLES AND REGISTERS

- A. Grilles shall be types as scheduled on the plans.
- B. Frame types and styles shall be compatible with the specified mountings.
- C. Aluminum Return Grills
  1. Aluminum return grilles shall have 3/4 inch blade spacing of the sizes and mounting types shown on the plans and outlet schedule. The fixed deflection blades shall be available parallel to the long or short dimension of the grille. Construction shall be of extruded aluminum with a 1-1/4 inch wide border on all sides. Minimum border thickness shall be 0.040-0.050 inch. Sizes 24 x 24 inches and small shall be constructed using a roll-formed frame.
  2. Corners shall be welded with full penetration resistance welds. Sizes larger than 24 x 24 inches shall be constructed by using heavy aluminum extrusions and shall be interlocked at the four corners and mechanically staked to form neat appearance.
  3. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be firmly held in place by mullions from behind the grille and fixed in place by crimping or welding. Blade deflection angle shall be available at 35°/
  4. Optional opposed blade volume damper shall be constructed of heavy gauge steel or aluminum. Damper must be operable from the face of the grille.
  5. The grilled finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
  6. The manufacturer shall provide published performance data for the grille. The grilled shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.
- D. Aluminum Supply Grilles
  1. Aluminum supply grilles shall be double deflection of the sizes and mounting types shown on the plans and outlet schedule. The deflection blades shall be available parallel to the long dimension of the grille or register. Construction shall be of aluminum with a 1-1/4 inch wide border on all sides. Sizes 24 x 24 inches and below shall have roll-formed borders with a minimum thickness of 0.032 inch. Larger sizes shall be constructed using continuous aluminum extrusions with a nominal thickness of 0.040 through 0.050 inch and shall be interlocked at the four corners and mechanically staked to form a rigid frame. Screw holes shall be countersunk for a neat appearance.
  2. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be spaced on 3/4 inch centers. Blades shall have friction pivots on both sides to allow individual blade adjustment without loosening or rattling or be inserted through the frame and held tight with steel friction wire interlocked to the frame on both ends of each side. Plastic blade pivots are not acceptable.
  3. Optional opposed blade volume damper shall be constructed of heavy gauge steel or aluminum. Damper must be operable from the face of the grille.

4. The grille finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
5. The manufacturer shall provide published performance data for the grille. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

## 2.4 DIFFUSERS

### A. SQUARE PLAQUE

1. Available Models:
  - a. OMNI Steel
  - b. OMNI-AA Aluminum
2. Architectural square panel ceiling diffusers shall be equal to the Titus Model OMNI diffuser of the sizes and mounting types shown on the plans and outlet schedule. The OMNI diffuser shall have an 22-gauge steel face panel that captures a secondary 22-gauge panel. The face panel is removable by means of four hanger brackets. The exposed surface of the face panel shall be smooth, flat, and free of visible fasteners.
3. The face panel shall project 1/4 inch below the outside border of the diffuser backpan. Panels projecting more than 1/4 inch below the outside border are not acceptable. The back of the face panel shall have an aerodynamically shaped, rolled edge to ensure a tight horizontal discharge pattern. A single metal thickness on the edges of the face panel will not be accepted. Ceiling diffusers with a 24 x 24-inch full face shall have no less than an 18 x 18-inch face panel size.
4. The backpan shall be one piece precision die-stamped and shall include an integrally drawn inlet (welded-in inlets and corner joints are not acceptable). The diffuser backpan shall be constructed of 22-gauge steel. The diffuser neck shall have a minimum of 1-1/4-inch depth available for duct connections.
5. The finish shall be #26 white. The finish shall be anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 25-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
6. Round damper shall be constructed of heavy gauge steel. Damper must be operable from the face of the diffuser. Directional Blow clips shall be available to restrict the discharge air in certain directions.
7. The manufacturer shall provide published performance data for the square panel diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-2006.

## 2.5 EGGCRATE RETURN GRILLE

- A. Sight-proof Aluminum Grid – Aluminum Border.
- B. Return grilles shall be equal to Titus Model 45°F for the sizes and mounting types as shown on the plans and outlet schedule. Return grilles must prevent line of sight when viewed directly from the face and provide a free area perpendicular to the 45 degree openings of at least 90%. Outer borders shall be constructed of heavy extruded

aluminum with a thickness of 0.040-0.050 inch and shall have countersunk screw holes for a neat appearance. Border width shall be 1-1/4 inches on all sides and shall be interlocked at the four corners and mechanically staked to form a rigid frame. Aluminum grid: 1/2 x 1/2 x 1/2 inch x 45 degree deflection

- C. The grille finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- D. The manufacturer shall provide published performance data for the grille. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Mount grilles to provide sight proof view.
- B. Grilles and registers shall be securely and neatly attached to the building construction or sheet metal duct flanges.
- C. Adjust front and rear blades for draft free air pattern.
- D. Diffusers shall be securely mounted to the sheet metal duct construction.
- E. Where grilles, registers, or diffusers are permitted to be connected to the duct system by flexible duct; the inner non metallic metal duct shall be connected using a stainless steel drawband and the outer insulation/vapor barrier shall be attached using a plastic or stainless steel drawband. If a plastic drawband is used it must be plenum rated. The use of duct tape or insulating tape as the means of attachment is not acceptable.
- F. Drop ducts from bottom of supply duct to diffuser shall be same size as the diffuser neck duct collar.
- G. Coordinate exact locations of grilles, registers and diffusers with other trades to avoid interferences.
- H. Paint ductwork visible behind air outlets and inlets flat black with flat black enamel spray paint.
- I. Grilles or registers mounted on a painted masonry wall shall have silicon sealant applied around the entire perimeter of the grille/register in a color matching the wall.

END OF SECTION

## SECTION 23 41 00 - PARTICULATE AIR FILTRATION

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes specifications for air system filters. Included are the following requirements:

#### 1.2 RELATED WORK

- A. Section 23 07 00 – HVAC Insulation
- B. Section 23 54 00 – Furnaces

#### 1.3 REFERENCE

- A. Provisions of Division 01 govern work under this section.

#### 1.4 REFERENCE STANDARDS

- A. ASHRAE Standard 52
- B. UL 181
- C. UL 586

#### 1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.

#### 1.6 SUBMITTALS

- A. Include data concerning efficiencies, airflow capacities, air pressure drop, dimensions, materials of construction, installation instructions and appropriate identification.

#### 1.7 DESIGN CRITERIA

- A. Use UL Class 1 or Class 2 filters unless noted otherwise.
- B. Efficiencies indicated in this section are based on ASHRAE Standard 52.
- C. Fan motors have been selected to operate against the resistance of midlife filters as specified in this section.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. All model numbers listed in the section are based on Farr filtration products. Equivalent products as manufactured by American Air Filter, Flanders/CSC, Flanders/Precisionaire, Eco-air, Purafil, are also acceptable.

## 2.2 CARTRIDGE FILTER MEDIA

- A. Use cartridge type, 4" deep extended surface high efficiency filter media in a factory fabricated filter frame. Farr Riga-Flow type filter.
- B. Rating: ASHRAE 52; 60 percent dust spot efficiency; 500 FPM face velocity (max.), initial resistance, 0.30 inch WG. Recommended final resistance 1.2 inch WG
- C. Furnish a side access filter housing or holding frame as scheduled or utilize air handling unit filter housing section.

## 2.3 HOUSINGS FOR PANEL FILTERS

- A. Manufactured by the terminal unit manufacturer, filter media manufacturer or Contractor fabricated. Casing and tracks shall be constructed of galvanized or enameled steel or aluminum. Provide access to the media tracks from outside the casing so media can be readily changed.

## 2.4 SIDE ACCESS FILTER HOUSINGS

- A. Galvanized steel housing with aluminum or galvanized steel filter mounting tracks. Mounting tracks and access doors shall have gaskets to eliminate air bypass around the filters. Housing assembly shall be compatible for use in duct systems with \_\_\_\_\_ inch WG of [positive] [negative] static pressure.
- B. Standard filter sections provided by air handling unit manufacturers may be used for 90% efficient filters but is not acceptable for HEPA filters.
- C. For housings separate from the air-handling unit, insulate the housings where the adjacent duct or air handling apparatus is insulated. Insulation shall be contained within a double wall steel panel and meet the requirements specified for adjacent duct or apparatus.
- D. Furnish a door on each end of the housing to facilitate filter changing. Doors to be hinged and provided with lever handle latches to secure the door. Doors shall not be secured with nuts, bolts, wing nuts, or sheet metal screws.
- E. Include an integral pre-filter track for installation of 25-30% efficient prefilters. Filter racks shall be provided with a 3" space between the pre-filter and final filter mounting tracks to allow for the installation of a static pressure tap between the filters.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Where air-handling equipment is to be used for temporary heating or ventilation of a facility, do not operate the equipment until specified filter media has been installed. Contractor shall be responsible for maintaining the cleanliness of air handling apparatus and air distribution systems during construction through regular inspection and changing of filter media throughout the construction period.

- B. Where air-handling apparatus is used during the construction period, install new filter media prior to start of air balancing. Additionally, deliver one new set of media to the project site prior to substantial completion.
- C. Install units as shown on drawings and details according to manufacturer's instructions and recommendations.
- D. Reinforce filter-holding frames per manufacturer's instructions.
- E. Maintain necessary clearance for changing filters.

END OF SECTION

This Page Intentionally Left Blank



## SECTION 23 51 00 - BREECHINGS, CHIMNEYS AND STACKS

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes specifications for vent piping, breechings, chimneys, stacks, emergency generator exhaust pipe, and automatic vent dampers. Included are the following requirements:

#### 1.2 RELATED WORK

- A. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- B. Section 23 07 00 – HVAC Insulation

#### 1.3 REFERENCE

- A. Provisions of Division 01 govern work under this section.

#### 1.4 REFERENCE STANDARDS

- A. UL 959
- B. ANSI/ASTM C64
- C. ANSI/ASTM C105
- D. ANSI/ASTM A525 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dipped Process
- E. ASTM A527 Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dipped Process, Lock-Forming Quality
- F. ASTM A53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- G. ASTM A234 Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

#### 1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.

#### 1.6 DESIGN CRITERIA

- A. Follow the requirements of NFPA 211 and State codes.
- B. Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.

## 1.7 SUBMITTALS

- A. Submit product data sheets and fabrication/installation drawings for all breeching, chimneys, and stacks specified within this section. Include a schedule identifying materials of construction, air space, insulation type and thickness, wall gauge, method of reinforcement, joint construction, fitting construction, and support methods with details.

## PART 2 - PRODUCTS

### 2.1 VENTS FOR CONDENSING FURNACES

- A. Provide vents, fittings, and accessories constructed of schedule 40 CPVC in accordance with appliance manufacturer's recommendations where applicable.
- B. Size vents in strict accordance with appliance manufacturer's requirements.
- C. Provide necessary supports for a complete installation.

### 2.2 DOUBLE WALL TYPE "B" GAS VENTS AND BREECHING

#### A. MANUFACTURER

- 1. Selkirk Metalbestos, Hart & Cooley, General Products Co. or Metal-Fab.

#### B. DESCRIPTION

- 1. Vent pipe, breeching and accessory fittings to be UL listed type "B".
- 2. Fabricate inner pipe of sheet aluminum or stainless steel, and outer pipe of galvanized sheet steel, tested in compliance with UL 441. Minimum thickness of inner and outer pipes to be as follows:

| <u>Vent Size</u>  | <u>Inner Pipe</u> | <u>Outer Pipe Thickness</u> |
|-------------------|-------------------|-----------------------------|
| Round, up to 6"   | 0.012"            | 28 gauge                    |
| Round, 7" to 18"  | 0.014"            | 28 gauge                    |
| Round, 20" to 24" | 0.018"            | 26 gauge                    |
| Oval, up to 4"    | 0.012"            | 28 gauge                    |
| Oval, 5" and 6"   | 0.014"            | 28 gauge                    |

- 3. Provide required accessories including flashing, counter flashing, storm collar, insulated thimble, rain cap with bird screen, clean out and fittings.
- 4. Provide necessary supports for a complete installation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. CONDENSING APPLIANCE VENTS

- 1. Pitch exhaust vents up from appliance to point of termination outside building.
- 2. Locate exhaust termination and combustion air intake in accordance with appliance manufacturer's recommendations to prevent re-entry of products of combustion.
- 3. Termination of exhaust within 10 feet of operable windows, other building openings, or air intakes is not acceptable.

4. Pitch combustion air vents from intake down toward appliance connection.
5. All joints of combustion air and exhaust vents shall be air tight. Provide drain connection at base of exhaust vent, and pipe to nearest open site drain.

### 3.2 CLEANING AND PROTECTION

- A. Clean breeching internally during installation to remove dust and debris. Clean external surfaces to remove welding slag and mill film.
- B. At ends of breeching and chimneys which are not connected to equipment, provide temporary closure to prevent entrance of dust and debris until final connections are made.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 23 54 00 - FURNACES

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section contains specifications for gas fired heating and cooling furnaces for this project. Included are the following requirements:

#### 1.2 RELATED WORK

- A. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
- B. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- C. Section 23 09 23 – Temperature Control System (DDC)
- D. Section 23 09 93 – Sequence of Operation for HVAC Controls
- E. Section 23 11 00 – Natural Gas Fuel Systems
- F. Section 23 23 00 – Refrigerant Piping
- G. Section 23 31 00 – HVAC Ducts and Casings
- H. Section 23 33 00 – Air Duct Accessories
- I. Section 23 51 00 – Breechings, Chimneys and Stacks
- J. Section 23 63 13 – Air-Cooled Condensing Units
- K. Division 26 – Electrical

#### 1.3 REFERENCE

- A. Provisions of Division 01 govern work under this Section.

#### 1.4 REFERENCE STANDARDS

- A. NEC National Electric Code for pre-wired electrical components.
- B. UL Underwriters Laboratories for electrical components.
- C. AGA American Gas Association for gas system components
- D. CGA Canadian Gas Association for gas system components
- E. GAMA Gas Appliance Manufacturers Association (Efficiency Rated Certified)

#### 1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.

## 1.6 SUBMITTALS

- A. Submit shop drawings for equipment specified under this section. Include data concerning sizes, dimensions, weights, heating and cooling capacities, materials of construction, ratings, electrical data, wiring diagrams, controls, options and manufacturers installation requirements, instructions and recommendations.

## 1.7 DESIGN CRITERIA

- A. Unit wiring and control components shall be factory installed, pre-wired and labeled.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. York, Trane, Carrier, Lennox, or RUUD.

### 2.2 CASING

- A. Steel with rust resistant paint finish, minimum ½" thick glass fiber internal insulation and access panels for required inspection and servicing access.

### 2.3 FAN AND MOTOR

- A. Direct Drive centrifugal fan with ball bearing supports and bearing grease extensions where required to an accessible location.
- B. Fan motor shall be resiliently mounted, NEMA approved, open ball bearing type with adjustable wiring taps on a terminal block for fan speed control.

### 2.4 HEAT EXCHANGER

- A. Heat exchanger shall be constructed of welded aluminized or ceramic coated steel and include a 20 year minimum non-prorated heat exchanger warranty. Heating section burner shall be aluminized steel for natural gas firing.

### 2.5 GAS CONTROLS

- A. Automatic gas valve adjustable gas pressure regulator main, a pilot gas electric ignition and a heat exchanger high temperature limit cut out control.

### 2.6 COOLING COIL

- A. Direct expansion with low pressure drop liquid distributor, copper tubes, aluminum fins and at least 400 PSIG allowable working pressure.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. The units shall be installed and placed in operation in strict accordance with the unit manufacturer's recommendations.

- B. The units shall be mounted level on concrete pads as specified on the plans.
- C. Provide condensate drain lines for heat exchanger and cooling coil condensate. Provide for the cooling coil a drain line loop seal. Extend drain lines to the nearest floor drain and pitch drain line down in direction of flow.
- D. Provide flexible connection at each duct connection.
- E. Fan speed shall be adjusted by the Contractor at the job site to provide the system design air volume.
- F. Openings in casings around piping shall be sealed airtight with sheet metal blankoffs and caulking.

END OF SECTION

This Page Intentionally Left Blank



## SECTION 23 63 13 - AIR-COOLED CONDENSING UNITS

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes requirements for air cooled refrigeration compressor-condensing units that are used with equipment specified in other sections. Included are the following topics:

#### 1.2 RELATED WORK

- A. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
- B. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- C. Section 23 23 00 – Refrigerant Piping
- D. Section 23 54 00 – Furnaces

#### 1.3 REFERENCE

- A. Applicable provisions of Division 01 govern work under this Section.

#### 1.4 REFERENCE STANDARDS

- A. ARI-210 Air Conditioning and Refrigeration Institute Standard 210
- B. UL Underwriters Laboratory

#### 1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.

#### 1.6 DESIGN CRITERIA

- A. Units shall be scroll, or reciprocating, hermetic type, packaged air cooled compressor-condensing units.

#### 1.7 SUBMITTALS

- A. Submit for equipment specified under this section. Include data concerning sizes, dimensions, weights, cooling capacities, materials of construction, ratings, electrical data, wiring diagrams, controls, options and manufacturers installation requirements, instructions and recommendations. The Manufacturer shall submit along with the unit shop drawings, complete refrigeration piping diagrams and electrical wiring diagrams. The refrigeration piping diagrams shall show piping details, sizes, manufacture and model numbers of piping, shut-off valves, expansion valves, solenoid valves, hot gas valves, filter-driers, sight glasses, interconnecting and line wiring for the refrigeration circuit. The piping and electrical wiring diagrams shall be prepared specifically for this project. Standard, incomplete general diagrams will not be accepted.

## 1.8 START UP

- A. The unit manufacturer shall provide the services of a factory trained serviceman to supervise the installation, refrigeration system evacuation, testing and charging and the initial start-up adjustment. Four copies of a written service report shall be submitted to the Engineer following the initial start-up. It shall be signed by the serviceman responsible for performing the start-up and adjustment work. The report shall state work done, indicate readings taken and shall certify that the unit has been placed in proper running condition as recommended by the unit manufacturer.

## 1.9 WARRANTY

- A. Provide five year warranty on the refrigeration compressors for parts.

## PART 2 - PRODUCTS

### 2.1 UNITS 5 TONS AND LESS

- A. ACCEPTABLE MANUFACTURERS
  - 1. The following Manufacturers are considered acceptable subject to compliance with the specified requirements listed below:
    - a. Carrier, McQuay, Trane, York, or Ruud.
- B. General
  - 1. Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure shall be factory wiring, piping, controls, compressor, full charge of [R-22][R-410a] refrigerant, and special features required prior to field start-up.
- C. Unit Cabinet
  - 1. Unit cabinet shall be constructed of galvanized steel and coated with a baked-enamel finish.
  - 2. Unit access panels shall be removable and shall provide full access to the compressor, fan, and control components.
- D. Fans
  - 1. Outdoor fans shall be direct-drive propeller type.
  - 2. Outdoor fan motors shall be totally enclosed; single-phase motors with class B insulation and permanently lubricated sleeve bearings. Motor shall be protected by internal thermal overload protection. Refer to Section 15170B for additional motor requirements.
  - 3. Shaft shall be resistant to corrosion.
  - 4. Fan blades shall be corrosion resistant and shall be statically and dynamically balanced.
  - 5. Outdoor fan openings shall be equipped with PVC coated protection grille over fan and coil.
- E. Compressor
  - 1. Compressor shall be fully hermetic reciprocation or scroll type.
  - 2. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from overtemperature and overcurrent. Scroll compressors shall also have high discharge gas temperature protection if required.

3. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere.
  4. Reciprocating compressors shall be equipped with crankcase heaters to minimize liquid refrigerant accumulation in compressor during shutdown and to prevent refrigerant dilution of oil.
  5. Compressor assembly shall be installed on rubber vibration isolators and shall have internal spring isolation.
- F. Outdoor Coil
1. Coil shall be constructed of aluminum fins mechanically bonded to internally enhanced, seamless copper tubes, which are cleaned, dehydrated, and sealed.
- G. Refrigeration Components
1. Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader type fittings with brass caps, accumulator, pressure relief, and a full charge of refrigerant.
- H. Controls and Safeties
1. Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:
    - a. Controls:
      - 1) Time delay restart to prevent compressor reverse rotation on single-phase scroll compressors.
      - 2) Automatic restart on power failure.
      - 3) Safety lockout if any outdoor unit safety is open.
      - 4) A time delay control sequence provided either through the fan coil board, thermostat, or controller.
      - 5) High-pressure and liquid line low-pressure switches (HDC).
      - 6) Liquid line low-pressure switches (HDL).
      - 7) Automatic outdoor-fan motor protection.
      - 8) Start capacitor and relay (single-phase units without scroll compressors).
    - b. Safeties:
      - 1) System diagnostics.
      - 2) Compressor motor current and temperature overload protection.
      - 3) High-pressure relief.
      - 4) Outdoor fan failure protection.
- I. Electrical Requirements
1. Unit electrical power shall be a single point connection.
  2. Unit control voltage to the indoor-fan coil shall be 24 v.
  3. Line and low voltage terminal block connections.
- J. Optional Features (Field Installed)
1. Liquid Solenoid Valve:
    - a. This electronically operated shutoff valve shall close and open in response to compressor operation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. The units shall be mounted level in accordance with the manufacturer's recommendations and requirements.
- B. The units shall be installed and placed in operation in strict accordance with the unit manufacturer's instructions and recommendations.
- C. Each unit shall be mounted on a 3½" high concrete pad as indicated on the plans. Concrete pads will be provided by other sections of work.

END OF SECTION

## SECTION 23 72 23 - FIXED PLATE AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes specifications for air-to-air energy recovery equipment for recovering heating and/or cooling energy that is used on this project. Included are the following topics:

#### 1.2 REFERENCE

- A. Applicable provisions of Division 01 govern work under this Section.

#### 1.3 RELATED WORK

- A. Section 23 07 00 – HVAC Insulation
- B. Section 23 09 23 – Direct Digital Control System for HVAC
- C. Section 23 09 93 – Sequence of Operations for HVAC Controls
- D. Section 23 33 00 – Air Duct Accessories
- E. Section 23 41 00 – Particulate Air Filtration

#### 1.4 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.
- B. ISO 9001
- C. Units constructed in accordance with CSA, C22.2 and UL 1812.
- D. Insulation shall comply with NFPA 90A requirements for flame spread and smoke generation.
- E. Warranty
  - 1. 2 year limited
  - 2. 15 year HRV Core

#### 1.5 SUBMITTALS

- A. Include unit dimensions, weights, materials of construction, thermal characteristics, ratings, fabrication methods, manufacturer's installation requirements, and appropriate identification.

#### 1.6 DESIGN CRITERIA

- A. Capacity, efficiency, and operating characteristics as specified on the drawings.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Liebert, Exothermics, Z Duct or Heatex .

### 2.2 CASING

- A. Unit construction shall consist of a structural extruded aluminum tube framing system, heavy gauge wall casing and a face/bypass damper section. Unit construction shall be compatible for indoor operation.
- B. Frame shall be constructed of extruded aluminum tubes and cast aluminum corners. Unit casing shall be double wall constructed of an 18 Ga. galvanized steel outer panel and a 22 Ga. galvanized steel inner panel having 1.5" thick, 1.5 lb. density insulation sandwiched between the inner and outer panels
- C. Provide units with hinged and gasketed access doors to allow manual cleaning of heat exchanger interior surfaces.
- D. Provide units with a weatherproof unit casing having both an outside air intake hood and an exhaust air discharge hood.

### 2.3 HEAT TRANSFER SECTION

- A. Heat exchanger shall be a flat plate, air-to-air type unit with no moving parts or secondary heat transfer surfaces. Heat exchanger shall be capable of withstanding differential pressures up to 10" W.C. and be capable of operation at temperatures up to 400°F. Plate corners shall be sealed with silicone and plate edges shall be sealed both mechanically and with sealant to prevent cross contamination. Plates shall be constructed of .008" thick aluminum housed in an aluminum tube frame
- B. The heat exchanger plates shall be smooth faced, having no dimples, corrugations or other raised surfaces where contaminants could deposit. Entire heat transfer surface shall be visible for inspection and cleaning without requiring removal of the exchanger.
- C. A drain pan(s) shall be provided beneath the exhaust and supply sides of the exchanger. Drain pans shall be welded, coated with bitumastic, and sloped to exterior drain connections. Drain connections shall protrude through the side of the unit.
- D. Heat exchanger design shall prohibit the mixing of the two airstreams.

### 2.4 EQUIPMENT

- A. Cores
  - 1. Modular aluminum heat recovery cores arranged for efficient cross-flow ventilation.
- B. Motors
  - 1. Two PSC, 3 speed double shafted, 120 VAC, 9.4 Amps each (18.8 total on high speed)
  - 2. HP - 1/2, 1625 RPM.
  - 3. Watts – total on high speed – 2256.
- C. Filters

1. Washable air filters in exhaust and supply air streams.
- D. Blowers
  1. Centrifugal type rated at 1200 CFM (566 L/s) free air delivery.
  2. Each air stream has one double shafted motor driving a centrifugal blower.
- E. Mounting
  1. Unit to be set on support brackets hung by threaded rod type apparatus (brackets and rods not included).
- F. Case
  1. 20 gauge pre-painted galvanized steel (G60) for superior corrosion resistance.
  2. Insulated with foil faced insulation duct liner wherer required to prevent exterior condensation.
  3. Drain connections, two – 1/2” (12 mm) O.D.
- G. Defrost
  1. Supply bypass routes indoor air to defrost core.
- H. Controls and Electronics
  1. Integrated microprocessor circuit board.
  2. Built-in interlock contacts.
  3. Automated Self Test.
  4. 99-BC01 – Lifestyle RNC Ventilation Control.
  5. 99-500 – 3 Speed Control.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install units in accordance with unit manufacturer's installation requirements in locations indicated on the drawings and as detailed.
- B. Provide hinged and gasketed access doors on the entering and leaving side of both airstreams for inspection and cleaning.
- C. Provide a magnahelic pressure gauge for both airstreams to measure the air pressure drop through the unit while in operation. Magnahelic pressure gauge range shall be as follows:
- D. Install duct thermometers in both the supply and exhaust airstreams at both the inlet and outlet connections to units.
- E. Coordinate insulation of unit casing with the Section 23 07 00 Contractor so that the casing is insulated in the manner specified or required by the unit manufacturer.
- F. Install filter rack with panel filters where outside air supply and exhaust air ductwork enter the unit.
- G. Connect to the condensate drain pan and extend a condensate drain line to the nearest floor drain.

END OF SECTION

This Page Intentionally Left Blank



## SECTION 23 82 13 - TERMINAL HEATING UNITS (ELECTRIC)

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section includes specifications for electric heating terminal equipment. Included are the following requirements:

#### 1.2 RELATED WORK

- A. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
- B. Section 23 33 00 – Air Duct Accessories
- C. Division 26 – Electrical

#### 1.3 REFERENCE

- A. Provisions of Division 01 govern work under this Section.

#### 1.4 REFERENCE STANDARDS

- A. UL standards for electrical equipment.

#### 1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.

#### 1.6 SUBMITTALS

- A. Include dimensions, capacities, electrical data, materials of construction, ratings, weights, wiring diagrams, and appropriate identification for equipment in this section. Include color selection charts where applicable.

#### 1.7 DESIGN CRITERIA

- A. Electrical Equipment and heaters shall be UL listed for the service specified.
- B. Electrical components and work must be in accordance with National Electrical Code.
- C. Electrical heating units shall be rated for the voltage and phase as specified on the plan schedules or within the drawings.
- D. All electrical items (except external control thermostats) shall be factory prewired to unit mounted electrical junction boxes and be enclosed within a control panel with numbered wiring terminals.

### PART 2 - PRODUCTS

#### 2.1 ELECTRIC UNIT HEATERS

- A. Manufacturers

1. Q Mark, Berko or Markel.
- B. Unit Casing
1. Steel with corrosion resistant coating finished in baked enamel with integral unit support points. Units shall have individually adjustable horizontal and vertical discharge louvers.
- C. Heating Element
1. Resistance type metal sheath finned tube in control steps as shown.
- D. Fan & Motor
1. Propeller type fan direct connected to a totally enclosed motor with internal motor overload protection and safety fan guard.
- E. Controls
1. Magnetic contactors for each control step, automatic resetting overheat cut-out, line voltage to low voltage control circuit transformer and a remote mounted, adjustable room thermostat with a 40°F to 80°F range.
- 2.2 ELECTRIC CABINET UNIT HEATERS
- A. Manufacturers
1. Q Mark, Berko or Markel.
- B. Cabinet
1. Steel with a baked on enamel finish in a color as selected by the Architect, removable front panel and access door to speed switch and integral thermostat (when so equipped). Unit types shall be configured as following in accordance with the schedules as specified on the plans:
    - a. Floor mounted type shall be free standing with front face air inlet and air discharge grille.
    - b. Surface wall mounted units shall be provided with top outlet grille and bottom inlet grille.
    - c. Semi-recessed, wall mounting type shall be provided with front face bottom inlet grille and top air discharge grille and overlapping recessing flange.
    - d. Fully-recessed, wall-mounting type shall be provided with front face mounted air inlet and discharge grilles and overlapping recess flange.
    - e. Ceiling surface mounted type shall be provided with rear inlet grille and a front or front bottom discharge air grille.
    - f. Ceiling recess mounted non-ducted units shall be provided with bottom inlet grille and air discharge grille.
    - g. Ceiling recess mounted ducted units shall be provided a front and rear duct collar connections.
  2. Provide inverted flow arrangement when specified.
- C. Heating Coils
1. Electric resistance elements mounted in fin tube bundle.
  2. Fans
  3. Centrifugal, double width, forward curved type.
- D. Controls
1. integral prewired disconnect switch, thermostatic fan switch to dissipate residual heat, thermostatic automatic high temperature cut out sensing temperature along

the full length of the coil, silent operating contactors to control the stages of heating and an integral control circuit transformer.

E. Motors

1. NEMA approved, resiliently mounted permanent split capacitor type of speeds indicated with speed selector switch.

2.3 ELECTRIC RADIANT CEILING PANELS

A. Manufacturers

1. Q Mark, Berko or Markel.

B. Heating element

1. Electrically resistive graphite sandwiched between two layers of insulation and enclosed in zinc-coated steel housing with 40" long flexible (BX) power connection.

C. Finish

1. Factory provided textured finish in a color and texture to match adjacent acoustical tile ceiling system. Pattern and color shall be as selected by the Architect.

D. Controls

1. Line voltage control thermostat or power relay with control circuit transformer and low voltage holding coil. Provide one power relay per room or thermostat. Do not exceed the maximum limitation rating of the power relay.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units in accordance with manufacturer's installation instructions.
- B. Coordinate location of units with other trades for correct recess size for recessed units.
- C. After installation, provide protective covers to prevent accumulation of dirt on units during balance of construction.
- D. Providing required line and low voltage control wiring.
- E. Protect finishes from damage during construction.

3.2 ELECTRIC UNIT HEATERS

- A. Suspend units from building structure and as high as possible to maintain headroom beneath units.

3.3 ELECTRIC CABINET UNIT HEATERS

- A. Install units at locations as specified on the drawings and as detailed.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Project Description:
- B. Section Includes:
  - 1. Electrical equipment coordination and installation.
  - 2. Access Panels
  - 3. Common electrical installation requirements.

#### 1.3 DEFINITIONS

- A. The Owner: **City of Madison**
- B. The Architect: **Assemblage Architects**
- C. The Engineer: Arnold & O'Sheridan, Inc., Consulting Engineers. Inc., **Brookfield**
- D. The Contractor: The Electrical Contractor, also referred to as "The Contractor".
- E. Code. National, State and Local Electrical codes including OSHA requirements.
- F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- G. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- H. Electrical ductbank: Assembly consisting of multiple electrical conduits embedded in earth or concrete.
- I. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- J. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- K. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

- L. Home Run: The portion of a branch circuit between the serving panelboard and the first electrical outlet, lighting fixture, or other electrical load connected to the circuit.
- M. High voltage: 35,001 volts and greater.
- N. Low voltage: 50 to 600 volts.
- O. Medium voltage: 601 to 35,000 volts.
- P. Provide. Furnish, install and wire ready for service.
- Q. Signal voltage. NEC class 1, 2, or 3 remote control, signaling, or power limited circuits.
- R. Substitution. Manufacturer or method other than those listed by name in these specifications, on the drawings, or in an addendum.

#### 1.4 ABBREVIATIONS

- A. A/E: Architect or Engineer
- B. ANSI: American Society for testing Materials.
- C. ETL: Electrical Testing Laboratories.
- D. FM: Factory Mutual.
- E. IEEE: Institute of Electrical and Electronic Engineers
- F. NEC: National Electrical Code, NFPA 70
- G. NECA: National Electrical Contractors Standards of Installation
- H. NEMA: National Electrical Manufacturer's Association
- I. NFPA: National Fire Protection Association
- J. OSHA: Occupational Safety and Health Administration
- K. UL: Underwriter's Laboratories

#### 1.5 SCOPE

- A. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work may not be specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.
- B. It is the intent that these Specifications and associated Drawings establish minimum requirements for products and equipment with the intent to provide electrical service, distribution and systems finished, tested and ready for operation. Incidental detail that is not

shown or specified, but necessary for proper installation and operation shall be included in the work and in these Contractor's estimates, the same as if specified. Locations of all equipment and material shall be adjusted at no extra cost to the Owner, to accommodate the work interferences anticipated and/or encountered. Prior to installation, determine the exact route and location of each raceway and piece of equipment to minimize conflicts with other trades.

- C. Information and components shown on riser diagrams but not shown on plans, and vice versa, shall be provided as if expressly required on both.
- D. It is the requirement of these Contract Documents to have the contractors provide systems and components that are fully complete, operational and suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements. In cases such as this, where the Contractor has failed to notify the Architect of the situation in accordance with Paragraph (A) above, the Contractor shall include in their bid the specific components or subsystems with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.
- E. The Contractor shall prepare and submit applications and working drawings to authorities having jurisdiction over the project. Licenses and permits required shall be secured and paid for by the Contractor. This includes required submittals for the fire alarm system.
- F. Standards and Codes: Work shall be installed in accordance with National, State, and Local codes, ordinances, laws, and regulations. Comply with applicable OSHA regulations. Materials shall have a UL or ETL label where a UL or ETL Standard or test exists.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than 0 deg F or exceeding 104 deg F.
  - 2. Humidity: Less than 95 percent (noncondensing).
  - 3. Altitude: Not exceeding 6600 feet, or 3300 feet if equipment includes solid-state devices.

#### 1.7 MODIFICATIONS IN LAYOUT

- A. Drawings are intended to outline the scope of work required and are not intended to be installation drawings. Drawings are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component nor do they show the exact routings. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational, nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.
- B. Unless specifically stated to the contrary, no measurement of an electric drawing derived by scaling shall be used as a dimension to work by. Dimensions noted on the electric drawings are

subject to measurements of adjacent and previously completed work. Measurements shall be performed prior to the actual installation of equipment.

- C. Prior to installation of visible material and equipment (including access panels) in finished spaces, review Architectural Drawings for desired locations and where not definitely indicated, request information from Architect.
- D. Check Contract Documents, as well as, Submittals and Shop Drawings of all subcontractors to verify and coordinate spaces in which work of Divisions 21 through 28 will be installed.
- E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades. Systems shall be run parallel with or perpendicular to major architectural and structural building elements.
- F. In the event of a conflict between the drawings and specifications, this Contractor shall base their bid on the greater quantity, cost or quality of the item in question, unless conflict is resolved by an addendum. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval.

#### 1.8 COORDINATION

- A. Coordinate arrangement, mounting, and support of equipment and raceways:
  - 1. To maintain maximum headroom; all piping, duct, conduit and associated components to be as tight as possible to underside of structure to provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 2. To allow right of way for piping installed at required slope.
  - 3. To allow connecting raceways, cables, wireways, cable trays, and busways to be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

#### 1.9 COORDINATION DRAWINGS

- A. When included as part of the Contract Documents, there shall be full cooperation and coordination of all specialty trades.
- B. This Division's contractors shall comply fully with the requirements set forth in the Division 23 Section "Coordination Drawings" specification section.

#### 1.10 RECORD DOCUMENTS

- A. Record Drawings are specified in Division 01 Section "Project Record Documents."
- B. The Contractor shall keep a detailed up-to-date record, of the manner and location in which installations are actually made, indexing each feeder, pull box and protective device. Record



documents are to reflect all changes in work including change orders, field directives, addenda from bid set of Contract Documents, request for information responses, etc. Upon completion of the project, the contractor shall modify the project electronic drawing and specification files to incorporate this information. Modified documents shall be turned over to the Owner in both electronic and hard paper copy formats. Record drawings shall also include:

1. Locations of buried conduit or similar items. Include buried depth.
2. Field changes of dimension or detail.
3. Details not on original contract drawings.
4. Changes to circuit numbers.
5. Junction box locations and conduit runs, with trade sizes indicated, for lighting, power, and electrical systems installed.
6. Master-slave light fixture ballasting arrangements.
7. Final panel schedules on drawings matching construction document drawing size.

#### 1.11 MATERIALS AND EQUIPMENT

- A. Materials and equipment required shall be new.
- B. Equipment supplied shall be based on materials and equipment of manufacturers specified. No substitutions are allowed except as permitted in this specification.
- C. Items specified shall be the latest type or model produced by the manufacturer specified. If descriptive specification or model number is obsolete, substitute the current product.

#### 1.12 SUBSTITUTIONS

- A. Substitutions shall not be allowed. Where the Contractor wishes to use equipment or methods other than those listed by name, that equipment must be approved by the Engineer. To gain approval for equipment not listed, the Contractor shall submit the following to the Engineer for his review:
  1. Documentation from the equipment manufacturer indicating where this equipment meets and does not meet the specifications or drawings as written. This documentation shall state exceptions taken to the specification and the reasons for exceptions. Documentation relative to the request shall be submitted on the manufacturer's letterhead and signed by a representative of the manufacturer.
  2. Manufacturer's Cut Sheets: Cut sheets shall be originals as are contained in the manufacturer's catalog. Photocopies of these sheets will not be accepted for review. (Furnish 3 copies.)
  3. Lighting Fixtures: Request for substitutions shall include photometric test reports performed by an independent testing laboratory.
  4. The Contractor shall provide samples of the proposed equipment for the Engineer's review, if requested by the Engineer.
  5. The Contractor shall furnish other information or materials as requested by the Architect/Engineer to establish equality.
  6. The Contractor shall acknowledge that they have reviewed the submission criteria for the request by stamping the submission with a review stamp or acknowledgement by an accompanying letter.
  7. Equipment and materials submitted for review without proper documentation shall be rejected without review.

- B. Submittal, including samples, shall be received in the Engineer's office 10 business days prior to bidding.
- C. Materials, equipment, or methods of installation other than those named, shall be in accordance with the general requirements and similar in composition, dimension, construction, capacity, finish and performance.
- D. Contractors submitting equipment for approval, shall include in their bids incidental costs that may result from the use of equipment. Costs shall include, but not be limited to, additional costs that may be incurred by other contractors whose scope of work is affected by use of the product. The Electrical Contractor shall be responsible for those costs even if they do not become evident until after bidding.

#### 1.13 MAINTENANCE MANUALS AND OPERATING INSTRUCTIONS

- A. Obtain at time of purchase of equipment, three copies of operation, lubrication and maintenance manuals for all items. Assemble literature in a coordinated manual using loose leaf sheets in a three ring binder(s). Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment. If it is desired to provide maintenance manuals in PDF format, the contractor shall provide a written request prior to submitting the manuals indicating which equipment manuals they propose to provide in this format.
- B. The manuals shall include the following and shall have an index of contents and tabs for each Specification Section and each piece of equipment specified in that Section and be provided in the order listed below, per Specification Section.
  - 1. Copies of all approved submittals/shop drawings.
  - 2. Manufacturer's operating and maintenance instructions and parts lists of all items or equipment. Where manufacturer's data includes several types or models, the applicable type or model shall be clearly designated.
  - 3. Startup and shutdown procedures.
  - 4. Test records.
  - 5. Wiring diagrams.
  - 6. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment.
  - 7. Owner's written acknowledgement of satisfactory completion of instruction period.
  - 8. Two sets of final shop drawings depicting equipment as installed.
- C. Furnish three copies of manuals to Architect for approval and distribution to Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit Owner's personnel to become familiar with equipment and operation prior to acceptance.
- D. Operating instructions: Upon completion of installation or when Owner accepts portions of building and equipment for operational use, instruct Owner's operating personnel in any or all parts of all systems. Factory-trained personnel shall perform instructions.
- E. Submittal Procedure and Format
  - 1. This Paragraph supplements Division 1.

2. No materials or equipment subject to prior review by the Engineer shall be fabricated or installed by the Contractor, without approval. The Engineer's review of shop drawings shall not relieve the Contractor of responsibility for deviations from the requirements of the drawings and specifications, unless prior approval for deviations has been granted.
3. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be 1/4 inches = 1 foot 0 inch scale unless specified otherwise.
4. Shop drawings and submittals showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data, alone, is not acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.
5. Provide shop drawing submittals showing details of piping connections to ALL equipment. If connection details are not submitted and connections are found to be installed incorrectly in the field, this contractor shall reinstall them within the original contract price.
6. Shop drawings for different systems and equipment shall be bound separately by specification section as indicated above and not bound by manufacturer. Each separate submittal shall have its own transmittal and cover letter. Submittals which contain different specification section systems bound together shall be returned un-reviewed for re-submittal.
7. Lighting Fixture shop drawings shall consist of two submittals, one for interior lighting and one for site lighting. Each submittal shall have all associated light fixtures included. Separate submittals grouped by manufacturer or supplier shall not be accepted. The contractor shall be responsible for coordinating drawings from his various suppliers in order to comply with this requirement.
8. The submittals must be approved before fabrication is authorized.

F. Required Shop Drawing Submittals

1. Submit to Engineer for review, the manufacturer's shop drawings and equipment brochures in quantities determined by the Architect for the following:
  - a. 26 05 19 - Low Voltage Wires, Cables, and Connectors
  - b. 26 05 26 – Grounding
  - c. 26 24 16 - Electrical Panelboards
  - d. 26 27 26 - Wiring Devices
  - e. 26 27 27 - Occupancy Sensors
  - f. 26 27 28 - Motor and Circuit Disconnects
  - g. 26 28 00 - Low Voltage Overcurrent Protective Devices
  - h. 26 32 00 - Standby Power Generator
  - i. 26 36 23 - Automatic Transfer Equipment
  - j. 26 51 13 – Interior Lighting

1.14 QUALITY ASSURANCE

A. Acceptable Manufacturers

1. The Engineer's design for each product is based on the manufacturer listed in the schedule or shown on the drawings. In Part 2 of some technical specifications, other manufacturers are listed as being acceptable. The listing of a manufacturer as acceptable does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein. These are acceptable only if, as a minimum, they:
    - a. Meet all performance criteria listed in the schedules and outlined in the specification.
    - b. Have identical operating characteristics to those called for in the specification. For example, a two-stroke diesel generator will not be acceptable if a four-stroke model is specified.
    - c. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean that the Engineer has determined that the manufacturer's products will fit within the available space - this determination is solely the responsibility of the contractor.
    - d. Products must adhere to all architectural considerations including but not limited to: being of the same color as the product scheduled or specified, fitting within architectural enclosures and details, and for diffusers, lighting and plumbing fixtures - being the same size and of the same physical appearance as scheduled or specified products.
  - B. All equipment shall be labeled or listed by the National Board of Underwriters Laboratories (U.L.) or other recognized listing/testing agency where such labeling or listing exists for such material.
  - C. All electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Skid-mounted or packaged assemblies shall be listed and labeled as an assembly, not just the individual components.
- 1.15 UTILITY CHARGES
- A. The contractor shall be responsible for costs from electric utility company that are assessed the Owner for the installation of the permanent electric service. It is the responsibility of the contractor to obtain those costs from the utility company and include them in their bid.
  - B. The contractor shall consult with the Electric Utility to verify service information specified herein and shown on drawings before submitting bid.
  - C. Consult with Electric Utility regarding service entrance requirements and metering equipment. Install metering equipment and empty conduit for metering conductors to meet standards and requirements of Electric Utility.
  - D. The contractor shall meet with the electric utility prior to rough-in to review and coordinate the installation of the electric service and verify existing conditions and special requirements.

- E. The service installation shall comply with the latest applicable standards of the utility. Refer to current electrical service installation manuals.

#### 1.16 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment/materials from damage during shipping, storage, handling and installation. Delivery equipment/materials to the site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- B. The Contractor shall provide for enclosed storage, when equipment/materials are stored on-site and prior to building "dry-in", to prevent any damage resulting from inclement weather or construction traffic. Specialties shall not be stored outdoors.
- C. Equipment/materials, stored or installed, found to be damaged shall be replaced with new by the Contractor, to the satisfaction of the Owner and at no additional expense. Do not store equipment with PVC material with exposure to direct sunlight.

#### 1.17 SPARE PARTS

- A. Requirements for spare parts are outlines in individual specification sections. Spare parts shall be turned over, unopened, to the Owner as part of the maintenance manual submittal.

### PART 2 - PRODUCTS

#### 2.1 CEILING ACCESS AND ACCESS PANELS

- A. Access panels are generally not shown on the drawings, but they are required to be provided by Contractor.
- B. Access panels shall be of size required to provide adequate access to equipment. Minimum size shall be 12" X 12" for hand access or 24" X 24" for body access. Minimum 16 gauge frame, not less than 18 gauge hinged door panel. Door locks shall be screwdriver operated for panels in general location applications and shall be key locked for public area applications.
- C. Furnish access panels for installation under other Sections valves or other items installed under this Division require access and are concealed in floor, wall, furred space or above ceiling. Access panels shall be by Milcor, Knapp, Nystorm or Inland Steel; coordinate selection with other Sections supplying similar access panels. Color of panel shall be selected by the Architect.
- D. Panels shall include concealed hinges, cam type locking devices, and shall have a frame border type necessary for the particular wall or ceiling construction in which they are installed. Access panels shall be flush mounted, recessed frame type units. Access panels shall be prime coated steel, for field painting for general applications and stainless steel for use in toilet rooms, shower rooms, and similar wet locations.
- E. Access panels shall have same fire rating classification as surface penetrated. Rated access panels must have U.L. Label.

#### 2.2 FIRESTOPPING

- A. Manufacturers:
  - 1. 3M Corporation.
  - 2. Rectorseal Corporation.
- B. Fire stopping materials shall include, but not be limited to, mortars, sealants and caulks, putties, collars, intumescent wrap strips mastics, and firestop pillows. Materials and methods used shall be recognized by an independent testing agency and shall have flame and temperature ratings assigned by that agency.
- C. Materials using solvents or those requiring hazardous waste disposal shall not be used.
- D. The firestop assemblies shall meet fire test and hose stream test requirements of an independent testing agency.

### PART 3 - EXECUTION

#### 3.1 PRE-BID SITE VISIT

- A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this division. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by an experienced observer.
- B. Contractor shall visit job site to familiarize himself with the specific location of the new equipment installations in existing areas, to ensure there is adequate access for the installation of equipment. All entries, pathways, corridors, stairwells, etc., that may be used to install equipment shall be investigated. All existing conditions and potential obstructions that may impede access and installation shall be addressed prior to equipment purchasing/ordering.
- C. The documentation of existing conditions was derived from As-Built documents and are in part unverified. Actual existing conditions shall be verified prior to commencement of work.

#### 3.2 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1 – Standard Practices for Good Workmanship in Electrical Contracting.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

- F. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

### 3.3 CONCRETE PADS

- A. Construct concrete bases of dimensions indicated but not less than [4 inches] larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
- D. Provide raised concrete pads for all floor mounted electrical equipment, including but not limited to, switchboards, transformers, motor control centers, transfer switches, lighting control/dimmer cabinets, and motor controllers.

### 3.4 FIREPROOFING:

- A. Openings in fire rated construction and annular spaces around conduits, cable trays, and other penetrating items shall be protected in accordance with NEC article 300.21 and in accordance with the Wisconsin Administrative Code, Department of Safety and Professional Services (SPS). The fire rating of the protective seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the construction is maintained.
- B. Wall or floor penetrations openings shall be as small as possible.
- C. Openings and annular spaces required by code to be protected, shall be protected whether specifically indicated on the plans or not.
- D. Installation of materials and assemblies shall be in strict accordance with the manufacturer's instructions.
- E. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, prior to start of spray fiber work.
- F. Piping and other items which would interfere with proper application of fireproofing shall be installed after completion of spray fiber work.
- G. Patching and repairing of fireproofing due to cutting or damaging to fireproofing during course of work specified under this Section shall be performed by installer of fireproofing and paid for by trade responsible for damage and shall not constitute grounds for extra cost to Owner.

### 3.5 INSTALLATION ONLY ITEMS:

- A. Where this contractor is required to install items which he does not purchase, he shall coordinate their delivery and be responsible for their unloading from delivery vehicles and for their safe handling and field storage up to the time of installation. This contractor shall be responsible for:
  - 1. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
  - 2. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.
- B. This Contractor shall carefully examine such items upon delivery. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of work of this Contractor will be considered only if presented in writing within one week of their date of delivery. Unless such claims have been submitted, this Contractor shall be fully responsible for the complete reconditioning or replacement of the damaged items.

### 3.6 PAINTING

- A. Furnish one can of aerosol-free touch-up paint for each different color factory finish which is to be the final finished surface of the product.

### 3.7 CLEANING

- A. Cleaning shall be performed prior to equipment being energized .
- B. Raceways
  - 1. General:
    - a. Cover all raceway openings prior to the installation of conductors to prevent dirt, moisture, and other debris from entering the raceways.
    - b. Before pulling conductors, swab out all raceways to remove any debris that may have entered raceways during construction or during storage.
    - c. When external surfaces of raceways or enclosures are rusted, clean and restore surfaces to original condition.
  - 2. Equipment
    - a. After completion of work but prior to turning equipment over to the Owner, clean the exterior surfaces to be free from concrete residue, dirt, paint residue, etc.
    - b. All dirt, drywall dust, and all other foreign matter shall be blown from, wiped away, or vacuumed from transformer coils, terminal devices, panelboard interiors, switchboard interiors, junction boxes, pullboxes, and other similar equipment enclosures.
    - c. Thoroughly clean equipment of all stains, paint spots, dirt, and dust. Remove all temporary labels not used for instruction or operation and remove all visible trade labels.



### 3.8 TESTS and ACCEPTANCE

- A. The operation of the equipment and electrical systems does not constitute an acceptance of the work. The acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.
- B. After the work is completed and prior to acceptance, the Contractor shall conduct the following tests, tabulate data, date, sign and submit to the Engineer:
  - 1. Standard megger insulation test on each feeder.
  - 2. Ground resistance test.
  - 3. Clamp ammeter test on each feeder conductor with utilization equipment energized. The load current in each phase conductor of the feeder or the portion thereof supplying the panel shall not differ from the average connected load currents in the feeder conductors by more than 7½%. If the load current does differ by more than 7½%, the Contractor shall change phase loading to same or receive written approval from the Engineer that this is not required due to the nature of the load.
- C. Upon completion of the installation, the Contractor shall furnish certificates of approval from authorities having jurisdiction. The Contractor shall demonstrate that work is in perfect operating condition, with race way and conduit system properly grounded, wiring free from grounds, shorts, and that the entire installation is free from physical defects.
- D. In the presence of the Engineer and the Owner, the Contractor shall demonstrate the proper operation of miscellaneous systems.
- E. Perform other test as specifically stated in other sections of the specification for specific equipment.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 26 05 04 - INSPECTION AND TESTING OF ELECTRICAL EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. The work under this section includes the required cleaning, repair, adjustment, calibration, maintenance and testing of electrical equipment, as specified herein. This applies only to new electrical and existing electrical equipment being furnished, modified, worked on or serviced by this contractor for this project.

#### 1.2 RELATED WORK

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

### PART 2 - PRODUCTS

#### 2.1 Not Used.

### PART 3 - EXECUTION

#### 3.1 GENERAL INSPECTION AND CLEANING OF ELECTRICAL EQUIPMENT

- A. Review for physical damage and abnormal mechanical and electrical conditions.
- B. Items found to be out of tolerance, or defective as a result of the required testing, shall be reported to owner and engineer. Procedure for repair and/or replacement will be outlined. After appropriate corrective action is completed the item shall be re-tested.
- C. Compare equipment nameplate information with the latest single line diagram and report discrepancies.
- D. Verify proper auxiliary device operation and indicators.
- E. Check tightness of accessible bolted electrical joints. Use torque wrench method.
- F. Make a close examination of equipment and remove shipping brackets, insulation, packing, etc. that may not have been removed during original installation.
- G. Make a close examination of equipment and remove dirt or other forms of debris that may have collected in existing equipment or in new equipment during installation.
- H. Clean Equipment:
  - 1. Vacuum inside of panelboards, switchboards, switchgear, transformer core and coils, horizontal and vertical busducts, MCC's, fire alarm panels, comm/data, security panel, etc.
  - 2. Loosen attached particles and vacuum them away.
  - 3. Wipe insulators with a clean, dry, lint free rag.
  - 4. Clean insulator grooves.
  - 5. Review equipment anchorage.
  - 6. Review equipment and bus alignment.
  - 7. Check heater elements for operation and control.

8. Lubricate nonelectrical equipment per manufacturer's recommendations.

### 3.2 MEDIUM VOLTAGE AIR CIRCUIT BREAKERS AND CUBICLES

- A. Review for physical damage and cleanliness.
- B. Review anchorage.
- C. Mechanical operator tests shall be performed on both the breaker and its operating mechanism in accordance with the manufacturer's instructions.
- D. Check the tightness of the bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instructions for proper torque foot-pound levels.
- E. Check the cell fit and the element alignment, including the circuit breaker and bus stabs.
- F. Check the lowering and raising mechanism if the breaker is of this type or the horizontal levering-in mechanism.
- G. Verify the availability of maintenance devices for servicing and operating the equipment.
- H. Check heater elements for operation and control.
- I. Completely clean the interior of cubicle sections including bus work and insulators using the following methods:
  1. Loosen attached particles and vacuum them away.
  2. Wipe porcelain with a clean, dry lint free rag.
  3. Clean insulator grooves.
  4. Vacuum the inside of the switchgear and enclosure.

### 3.3 LOAD BREAK MEDIUM VOLTAGE SWITCHES (5 KV AND ABOVE)

- A. Check blade alignment and arc interrupter operation.
- B. Check fuse linkage and element for proper holder and current rating.
- C. Check each fuse holder for adequate mechanical support of each fuse.
- D. Verify interlocks and proper key distribution.
- E. Verify proper phase barrier, materials and installation.

### 3.4 GROUNDING SYSTEMS

- A. Review the ground system for adequate termination at devices.

### 3.5 LIGHTNING/SURGE ARRESTERS

- A. Review for physical damage such as chipped or fractured porcelain. Wipe clean.
- B. Perform a ground continuity test to ground system.
- C. Verify the proper mounting and adequate clearance.

- D. Verify the voltage of the units with system one line diagram. Report discrepancies.
- E. Verify that the electronic surge protection is connected properly and status lights are normal.

### 3.6 METERING AND INSTRUMENTATION

- A. Examine devices for broken parts, damage and wire connection tightness.
- B. Meter selector switches shall be inspected for proper application and operation.

### 3.7 BATTERY SYSTEMS

- A. Review for physical damage and evidence of corrosion. Clean units.
- B. Measure system charging voltage and each individual cell voltage.
- C. Measure the electrolyte specific gravity and level.
- D. Verify and compare measured values with manufacturer's specifications.

### 3.8 CABLES

- A. Visual and Mechanical Inspections:
  - 1. Review exposed sections for physical damage.
  - 2. Verify cable is supplied and connected in accordance with single line diagram.
  - 3. Review for shield grounding, cable support and termination.
  - 4. If cables are terminated through window type C.T.'s make an inspection to verify that neutrals and grounds are properly terminated for normal operation of protective devices.
  - 5. Review for visual jacket and insulation condition.
  - 6. Visible cable bends shall be checked against ICEA or manufacturer's minimum allowable bending radii -- 12 times the diameter for tape shielded cables.
  - 7. Review for proper fireproofing in common cable areas.
  - 8. There shall be NO tests performed on existing cable without specific direction from the Consulting Engineer.
- B. Electrical Tests -- Below 600 Volts:
  - 1. Secondary cables from the substation transformers to the secondary switchboards shall be subjected to insulation tests using a 500 vdc megger.
  - 2. Visually review cables, lugs, connectors and other components for physical damage and proper connections
  - 3. Check cable connectors for tightness (with a torque wrench) and clearances. Torque test conductor and bus terminations to manufacturer's recommendations.
  - 4. Check for proper grounding resistance at services and at transformers. Resistance shall be 2 ohms maximum.
  - 5. -- Above 600 volts:
  - 6. Above 600 volt testing to be performed under a separate contract.

### 3.9 PANELBOARDS

- A. Torque the connections per the manufacturers spec. Verify phase wires, color coding, separate neutral and mechanical bonding. Verify circuit breaker operation. Verify the directory.

3.10 LIGHT FIXTURES

- A. Check the bonding and proper lamping. Verify that recessed fixtures are installed with hold down clips. Confirm operation of the fixture with the proper switch or sensor.

3.11 OCCUPANCY SENSORS

- A. Confirm operation of the sensor per the manufacturers spec.

3.12 GENERATOR

- A. Run the generator through the standard tests as recommended by the manufacturer including the load bank test. Test the automatic start circuits and run the diagnostic tests. Check for fuel and coolant leaks.
- B. Provide full load testing utilizing a portable test bank for four hours continuous, minimum. During the first two hours, step increase the load from 0% to 100% in at least six equal steps. At the end of two hours, continue running test at 100% load. Record the following in 20 minute intervals throughout the four hour test: kilowatts, amperes, voltage, coolant temperature, room temperature, generator frequency (Hz), oil pressure, fuel consumption.
- C. After the generator has cooled down from the four hour test, shut it down and then simulate a power failure including operation of the transfer switch, automatic cycle, and automatic shutdown and return to normal.

3.13 AUTOMATIC TRANSFER SWITCHES

- A. Coordinate with the generator and the subsequent tests.

END OF SECTION

## SECTION 26 05 19 - LOW VOLTAGE WIRES, CABLES AND CONNECTORS

### PART 1 - GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Application requirements of Division 0 and Division 1 shall govern work under this Section.

#### 1.2 SCOPE

- A. Provide wires, cables and connectors as specified herein.
- B. Provide branch wiring and feeder systems to serve lighting, receptacles, motors, and other equipment loads.
- C. The terms “feeders” and “branch circuits” as used in this section are as defined in NEC Article 100.

#### 1.3 RELATED WORK

- A. Section 26 05 33 - Conduits
- B. Section 26 27 26 - Wiring Devices
- C. Section 26 05 26 - Grounding

#### 1.4 QUALITY ASSURANCE

- A. Reference Standards of the following associations:
  - 1. National Electrical Contractor's Association (NECA) - Standard of Installation
  - 2. Insulated Cable Engineers Association (ICEA)

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS

- A. Copper conductor only.
- B. Conductor insulation shall be rated 600 volts minimum. Insulation color for low voltage (secondary feeders and branch circuits) conductors shall vary to depict the type of conductor. Colors shall be as indicated elsewhere in this section and as required by code.
- C. Single conductor #10 AWG size and smaller for general use wiring may be stranded or solid conductors at the contractor's option, provided with type THWN insulation. Stranded conductors accessible with the use of compression (crimp) connectors. Minimum size shall be #12 AWG on 208 volt systems and #12 AWG for 480 volt systems. Conductors with dual rated insulations are approved provided one of the ratings is THWN.

- D. Single conductor #8 AWG and larger for general use wiring shall be stranded configuration with type THWN insulation. Conductors with triple rated insulations are approved provided the ratings include one of the ratings that are listed.
- E. Conductors installed in wet locations and areas with high humidity shall be type XHHW-2 or USE. Wet locations shall include, but not be limited to, conduits installed in contact with the earth and underground electrical ductbanks.
- F. Conductors shall not be installed at temperatures below the manufacturer's minimum installation temperature.
- G. Unless specifically indicated otherwise, conductor sizes indicated on the plans are based on the ampacities listed for conductors rated at 75 degrees C.
- H. All conductors, whether stranded or solid, shall be terminated using approved methods.
- I. Install 90°C conductor in high ambient temp. Mechanical room, utility rooms and exterior installation.

## 2.2 COMMUNICATIONS CABLES

- A. Communications cables shall be the type as called for in the specifications and drawings for the installation of various communications systems.
- B. Communications cables installed in cable trays shall be rated for use in cable tray and shall be of fire resistive construction.
- C. Cables routed exposed through return air ceiling plenums shall be smoke resistance teflon coated cable classified as type CLP or CMP communications cable.

## 2.3 JOINTS, TAPS AND SPLICES

- A. CONDUCTORS NO. 10 AWG AND SMALLER
  - 1. 3M Scotch-lok compression type solderless connectors with plastic cover.
- B. JOINTS, TAPS, AND SPLICES IN CONDUCTORS NO 8 AWG AND LARGER
  - 1. Solderless compression type connectors, tool and die applied, of a type that will not loosen (Non Reversing) under vibration or normal strains. Burndy "Hy-Dent" type or equivalent.

## 2.4 TAGS AND LABELS

- A. BRANCH CONDUCTOR LABELS
  - 1. Sleeve type wrap around adhesive markers with factory printed circuit numbers.
- B. FEEDER CONDUCTOR LABELS
  - 1. Metal tags or flame-resistant adhesive label tags at the Contractor's option. Label shall include conductor source, voltage, and load/equipment served.

## 2.5 RUBBER INSULATING ELECTRICAL TAPE

- A. Scotch 3M model 23, 30 mil tape.
- B. Plymouth #2117, 30 mil tape.



## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's written instructions and in accordance with recognized industry practices.
- B. Run wire and cable in conduit, unless otherwise indicated on drawings.
- C. Do not draw conductors into conduits until building is enclosed and watertight and until work that may cause conductor damage has been completed.
- D. Voltage drop for branch circuits and feeder circuit combined shall not exceed requirements of NEC Article 215.
- E. Examine areas and conditions under which conductors are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of work.
- F. Do not proceed with work until unsatisfactory conditions have been corrected.

### 3.2 JOINTS, TAPS AND SPLICES

- A. Each tap, joint, or splice in conductors No. 8 AWG and larger shall be taped with two half-lap layers of vinyl plastic electrical tape and a finish wrap of color coding tape, where required by code.
- B. Cable splices shall be made only in distribution and junction boxes.

### 3.3 WIRE AND CABLE IDENTIFICATION

#### A. TAGS AND LABELS

- 1. Install tags and or/labels on conductors and cables in junction boxes, pullboxes, wireways, wiring gutters of panels, and other accessible locations. Labels and tags shall contain information under "products" for branch circuit conductors and feeder conductors.
- 2. Conductor phase identification. Different conductor insulation colors and electrical tape colors shall be used to identify the different phases of conductors in a given circuit and to identify the neutral and ground conductors. Painted identification is not acceptable. Provide color identification on conductors at accessible locations. Requirements of the Code regarding conductor identification shall always be followed where applicable. In general, colors shall be as follows:
  - a. 120/240 Volt Systems Neutral Conductor - Solid White: Provide additional markings for neutral conductors in the same raceway.
  - b. 120/240 Volt Systems A-Phase, and B-Phase, Unswitched Legs: Solid black, and solid red respectively. Different colors shall be used to identify switched legs.
  - c. Ground Conductors - Solid Green: Provide additional markings for ground conductors in the same raceway.
- 3. For additions to existing buildings, existing conductor color-coding schemes shall be followed unless in conflict with the codes. If no logical color-coding scheme exists, color-coding indicated above shall be followed.

### 3.4 FIXTURE WIRES

- A. Use conductor with insulation rated for current, voltage, and temperature to which conductor is subjected. Conductors used as fixture wires shall be insulated with materials of the type recognized by the National Electrical Code, Article 402.
- B. Minimum wire size shall be selected as defined in NEC Article 240 for the branch circuit overcurrent device ampacity and conductor length involved.
- C. Insulation rated for operation at 90 degrees C. minimum for lighting fixtures with integral ballast, mogul base sockets, quartz lamps, or otherwise where subject to excessive temperatures.
- D. Fixture wiring shall be unspliced between branch circuits and lampholders (or ballasts) and unspliced between ballasts and lampholders.

### 3.5 FEEDER INSTALLATION

- A. Install in accordance with manufacturer's written instructions, and in accordance with recognized industry practices.
- B. Extend feeders at full capacity from origin to termination.
- C. Where feeder conductors are run in parallel, conductors shall be of same length, same material, circular- mil area, insulation type, and terminated in same manner.
- D. Where parallel feeder conductors are run in separate raceways, each raceway shall have same physical characteristics.
- E. Feeder conductors in switchboards, panelboards, pullboxes, gutters, and other open wiring spaces shall be bundled by feeder using plastic tie wraps at intervals not greater than 3' on center.

### 3.6 BRANCH CIRCUIT CONDUCTORS

- A. Install branch circuits and switched circuits to comply with the circuiting, switching, and functions shown on the drawings.
- B. Conductors shall be size 12 AWG minimum (unless otherwise noted) for branch circuit wiring, including motor circuits.
- C. Conductor shall increase the size of branch wiring one size ( i.e., from #12 AWG to #10 AWG) where the distance from the panel to the center of the load is more than 100 Feet long for 120V. circuits and 200 feet ;long for 277V. circuits.
- D. Provide individual neutral conductors for branch circuits serving isolated ground receptacles and computer equipment. (No common neutrals for these circuits.)
- E. Route branch circuits and switch legs as dictated by construction, these specifications, or instruction from Engineer.
- F. Size conduit, outlet boxes, and other raceway system components in accordance with NEC requirements as minimum.

- G. Circuit numbers as shown on drawings are for Contractor to plan his wiring and for estimating purposes and are not necessarily the exact circuit numbers to be used in that panel for that particular load. Exact circuit numbers for each load are to be selected by the Contractor at his option. Balanced load on panelboard bus is to be determining factor in arrangement of circuits. Panelboards average load shall not differ from phase to phase by  $\pm 7\frac{1}{2}\%$ .

### 3.7 MOTOR AND EQUIPMENT BRANCH WIRING

- A. Furnish and install motor circuits in accordance with schedules on drawings and code requirements, from source of supply to associated motor starter, and from starter to motor terminal box, including necessary and required intermediate connections.
- B. Conductor and conduit size for motor branch circuits if shown on drawings are sized for motor requirement only. Control wiring is not included in conduit sizes shown on the drawings.
- C. Motors shall have proper conductor sizes in accordance with NEC requirements and nameplate ratings. Contractor is responsible for verification of ratings of motors and installing proper branch circuits.
- D. Obtain manufacturer's wiring diagrams and shop drawings for equipment requiring electrical connections.
- E. Check drawings and specifications of other divisions of work for equipment and work which shall be included.
- F. Motor connections shall be made by compression type connectors using proper tools and fittings.

END OF SECTION

This Page Intentionally Left Blank

## SECTION 26 05 19.4 - MOTOR WIRING

### PART 1 - GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Applicable provisions of Division 0 and Division 1 shall govern work in this Section.

#### 1.2 SCOPE

- A. Provide connections and wiring to motors as shown in the motor wiring and special purpose outlets schedules, on the drawings and in other divisions of the specifications and as specified herein.

#### 1.3 RELATED WORK AND REQUIREMENTS

- A. Section 26 05 19 - Low Voltage Wires, Cables and Connectors
- B. Section 26 29 00 - Motor Starters

### PART 2 - PRODUCTS

- 2.1 Not Used.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Motor starters shall be furnished by the Contractor supplying the motor requiring a starter.
- B. This Contractor shall check the drawings and specifications of the other trades to determine the requirements for motor disconnect switches. In each case, the Contractor shall install required disconnect switches. The Electrical Contractor shall provide code required disconnect switches not specifically supplied by others.
- C. Unless otherwise indicated on the drawings or elsewhere in these specifications, motors shall be furnished by others.
- D. Motors shall be set in place and the associated motor starters and controllers shall be turned over to the Electrical Contractor for installation.
- E. Contractor supplying starters and controllers shall index same and provide the Electrical Contractor with written instructions as to proper location in time to permit the installation of a concealed raceway system.
- F. Control wiring, regardless of voltage, shall be the responsibility of the Contractor providing the motor. The Electrical Contractor shall extend the 120 volt circuit to the control transformers and make 120 volt transformer connections. Control transformers shall be supplied by HVAC Contractor. Location of control transformers shall be in close proximity of the heating equipment.

- G. Review the HVAC and plumbing specifications and provide line voltage wiring and connections to controls and auxiliary equipment specified as to be provided by the Electrical Contractor or Division 26.

END OF SECTION

## SECTION 26 05 26 - GROUNDING

### PART 1 - GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Applicable requirements of Division 0 and Division 1 shall govern work in this section.

#### 1.2 SCOPE

- A. Provide material, labor and incidentals necessary for the installation of a code compliant grounding system.

#### 1.3 RELATED WORK

- A. Section 26 05 00 - General Electrical Provisions
- B. Section 26 05 19 - Low Voltage Wires, Cables and Connectors

#### 1.4 APPLICABLE CODES

- A. National Fire Protection Association (NFPA), NFPA-70 - National Electrical Code (NEC) and Wisconsin amendments thereto.
- B. Local Codes and Ordinances.

#### 1.5 REFERENCE STANDARDS

- A. Conform to the standards of the National Electrical Contractors Association (NECA), Standard of Installation.

#### 1.6 SUBMITTALS

- A. Ground rod locations.
- B. Ground resistance at each ground rod.
- C. Soil conditions.
- D. Building water service resistance.

### PART 2 - PRODUCTS

#### 2.1 GROUND CLAMPS

- A. Ground clamp fittings shall be interlocking clamp type fabricated from high strength corrosion-resistant metal with high strength silicon bronze U-bolt, nuts, and lock washers.

#### 2.2 GROUND RODS

- A. Thick copper covering inseparably welded to a strong steel core.

- B. 3/4" diameter minimum.
- C. Ten feet long minimum.

## 2.3 GROUND WIRES

- A. Copper only.
- B. Size as shown on drawings, or required by NEC.
- C. No. 6 AWG minimum.

## 2.4 GROUND BUSSES

- A. Copper only.
- B. Cross section shall be 1/4" X 2", lengths shown on the plans or as required to accommodate ground connections.

# PART 3 - EXECUTION

## 3.1 GENERAL

- A. Ground electrical systems and equipment required by code, utility, local ordinances, and to requirements herein.
- B. Install separate code rated grounding conductors to special equipment and activity areas required by code.
- C. Bond metallic piping systems and service equipment required by NEC.
- D. Cable connections and joints shall be non-reversible compression connected or thermowelded.

## 3.2 SYSTEM GROUND

- A. Attach grounding electrode conductor to point ahead of water meter or service shut-off valve. Grounding electrode conductor shall be permitted to be attached to other grounding electrodes where available in the building as defined in NEC Article 250-81 in lieu of attaching to water service.
- B. Water piping system ground shall be augmented by 2 NEC grounding electrodes so as to achieve an effective ground resistance required by code and as shown on the plans. Building steel shall be used where available.
- C. Drive ground rods to a depth 4" below finished grade.
- D. Grounding electrode conductor shall be continuous without splice from nearest building grounding electrode. Ground to service equipment.
- E. Install bonding jumper around water meter.
- F. Attach non-ferrous metal tag to warn against removal at grounding electrode connections.



- G. Make connections to ground electrodes with molded exothermic weld process or non-reversible compression connectors.
- H. Provide ground from transformer location to grounding electrode system. This conductor shall be used to ground secondary side neutral, case and core in accordance with grounding requirements for a separately derived system.

### 3.3 EQUIPMENT GROUND

- A. Bond metallic conduits, supports, cabinets, and other equipment to provide an electrically continuous equipment ground from service to outlet boxes.
- B. Ground wire shall be bonded at equipment and at first junction box of conduit system on line side of conduit to the system.
- C. Install separate ground conductors in pvc raceway.
- D. Install grounding conductors to permit shortest path from equipment to ground. When grounding conductor runs through metallic conduit, bond to conduit at entrance and exit with a bolted clamp.
- E. Ground neutral at service only.
- F. Install a separate equipment grounding conductor in each conduit containing feeder conductors.
- G. Install a green equipment grounding conductor in conduits serving receptacles and special purpose outlets.
- H. Provide dedicated equipment grounding conductors with circuits serving isolated ground receptacles. Isolated ground conductors shall have a green jacket with a yellow stripe. Provide isolated ground bus in distribution equipment serving equipment with isolated ground requirements.
- I. Green ground bar in panels, where required to be similar to neutral bar, except tinted green and bonded to panel tub.
- J. Connections shall be accessible for inspection and checking. No insulation shall be installed over ground connections.
- K. Ground connection surfaces shall be cleaned and connections shall be made so that it is impossible to move them.
- L. Attach grounds permanently before permanent building service is energized.
- M. Ground metal lighting poles including equipment grounding conductor and driven ground rod at each pole. Install a ground lug on wall of pole directly across from handhole.
- N. Attach ground wire neatly and firmly to walls.

### 3.4 ELECTRICAL AND TELECOM ROOM GROUND BUSSES

- A. Provide where indicated on the plans or as required to accommodate equipment used.

- B. Minimum bus length shall be 24”.
  - C. Mount to walls with insulated standoffs.
  - D. At splice points, splice bus shall overlap busses being spliced by a dimension twice the width of the bus being spliced. Splice bus shall be connected to each bus with a minimum of two splice bolts.
  - E. Bus splice bolts shall utilize bellevue washers.
- 3.5 FIELD QUALITY CONTROL
- A. Contractor shall make ground resistance measurements. Measure in normally dry conditions, not less than 48 hours after rainfall. Submit measurements to Engineer upon request.

END OF SECTION

## SECTION 26 05 29 - SUPPORTING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Applicable requirements of Division 0 and Division 1 shall govern work in this section.

#### 1.2 SCOPE

- A. Provide equipment for the support of electrical equipment as detailed or indicated on the drawings and as specified herein.

#### 1.3 APPLICABLE STANDARDS AND CODES

- A. National Electrical Contractors Association (NECA), Standard of Installation.
- B. National Electrical Manufacturers Association (NEMA).
- C. American National Standards Institute (ANSI).

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Kindorf.
- B. Midland-Ross Corp.
- C. Steel City/Midland-Ross Corp.
- D. Unistrut.
- E. B-Line.
- F. Power-Srut.

#### 2.2 GENERAL

- A. Metal supporting devices shall be zinc galvanized or cadmium plated steel or malleable iron.

#### 2.3 LIGHTING FIXTURE SUPPORT

- A. Items including (but not limited to) stems, hickies, bar hangers, and clips required to securely attach fixtures to ceilings or walls.
- B. Studs and structural support for fixture outlet and ceiling support.
- C. Fixture grid hangers for mounting surface fluorescent units to exposed grid ceiling.
- D. Drilled expansion insert type anchors rated for load and application requirements including (but not limited to) sleeve anchors, lag shields, and plastic anchors.

- E. Provide auxiliary supports so that fixtures can be drawn up tightly, cannot be tilted or rotated, and not be affected by vibrations.

## 2.4 SUPPORT STRUCTURES

- A. Rack supports of galvanized steel channel sections with adequate feet to allow secure mounting.
- B. Weld sections, do not use bolts.

## 2.5 MOUNTING PANELS

- A. Size mounting panels to mount necessary equipment, of 3/4" exterior grade plywood as specified on drawings.
- B. Provide mounting panels for surface mounted electrical cabinets and enclosures for electrical equipment.
- C. Provide uniform mounting panels as far as practical. Preferred sizes being 12" X 18", 18" X 24", 18" X 30", and 24" X 30".

## 2.6 CONDUIT SUPPORTS

- A. Continuous slot or T-slot galvanized steel concrete insert channel.

# PART 3 - EXECUTION

## 3.1 PREPARATION

- A. Install hangers, supports, and anchors only after structural work, where work is to be installed, has been completed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors, and other building structural attachments.
- B. Examine areas and conditions under which equipment and associated components are to be installed and notify Architect, in writing, of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.
- C. Determine that ceiling channel system is adequately supported to receive and support lighting fixtures. Where deemed inadequate, do not install fixtures until additional support is provided.

## 3.2 LIGHTING FIXTURES

- A. Install channel supports across main grid runners or grid supports, securely tied down or anchored for fixtures and devices mounted in suspended ceiling systems so as not to cause tile to sag and so that fixture or device cannot be lifted, rotated, or displaced. Provide additional support of ceiling grid or tees at those locations where tiles and ceiling grid sags.
- B. Install grid troffer support clips in accordance with NEC 410-16(c).

### 3.3 INSTALLATION OF BUILDING ATTACHMENTS

- A. Install building attachments at required locations within concrete or on to structural steel or raceway and equipment support.
- B. Install additional building attachments where support is required for additional concentrated loads.
- C. Install concrete inserts before concrete is placed.

### 3.4 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31 and to prevent the transfer of loading and stresses to connected equipment.
- B. Installation methods shall be in conformity with the manufacturer's recommendations for maximum holding power, but in no case shall the depth of hole be less than four bolt diameters. Minimum distance between the center of expansion anchor and an edge of exterior corner of concrete shall be not less than 4½ times the diameter of the hole in which it is installed.

### 3.5 SUPPORT OF CONDUIT

- A. Fasten conduit to structural parts of building in a manner acceptable to Engineer.
- B. Do not use perforated hanger iron.
- C. See Section 26 05 33.
- D. Install concrete insert channel, with spacings as recommended by manufacturer. Install with anchor and caps, insert joiner clips and closer seals.
- E. Support conduit as follows:
  - 1. Single Conduit Runs:
    - a. Vertical Surfaces: Galvanized, heavy duty, sheet steel straps; back straps to be provided for exposed conduit and conduit on exterior walls.
    - b. Horizontal Surfaces: Galvanized, heavy duty, 2 hole steel pipe straps.
  - 2. Multiple Conduit Runs:
    - a. Vertical Surfaces: Horizontal or vertical rack channel with conduit straps.
    - b. Horizontal Surfaces: Single or double rack channel trapeze, with conduit straps and supported with threaded hanger rods.
  - 3. Conduits Passing Between Floors and Through Roof:
    - a. 1¼" and larger conduit runs passing through floors shall be supported at each floor with riser pipe clamps.
    - b. Conduit extending through roof shall pass through a ceiling box at roof lines.
    - c. Provide 14-gauge minimum copper box with watertight soldered seams and flanged to serve as pitch pocket for each conduit.
    - d. Conduit and pitch pocket shall be installed in advance of roofing work.

### 3.6 VERTICAL CABLE SUPPORT

- A. Conductors in vertical raceways shall be supported using cable supports. Locate supports so that each 25' length of conductor in a vertical raceway is supported.

END OF SECTION

## SECTION 26 05 33 - CONDUITS

### PART 1 - GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Drawings and General Provisions of Contract, General and Supplementary Conditions, and Division 1 Specifications, apply to this Section

#### 1.2 SCOPE

- A. Provide conduit systems for power wiring and communications systems as specified. Flexible, modular-wiring systems shall not be used.

#### 1.3 RELATED WORK AND REQUIREMENTS

- A. Section 26 05 19 - Low Voltage Wires, Cables and Connectors
- B. Section 26 05 26 - Grounding

#### 1.4 QUALITY ASSURANCE

- A. National Electrical Contractor's Association (NECA) Standard of Installation.
- B. National Electrical Code (NEC) including local supplements.

### PART 2 - PRODUCTS

#### 2.1 CONDUIT FITTINGS - GENERAL

- A. Fittings for metal raceways shall be steel, and shall be zinc galvanized or cadmium plated.
- B. Fittings for PVC raceways shall be of the type recommended by the raceway manufacturer.
- C. Do not use aluminum or die cast fittings.
- D. Do not use malleable iron.
- E. Do not use running threads.
- F. Do not use indentor type fittings.
- G. Box connector bushings shall have insulated throats. Integral grounding lugs shall be provided where required by code or detailed on the drawings and elsewhere in the specifications.
- H. Termination bushings for conduits that terminate in free air, as at cable trays, communications backboards, in electrical vaults, and in electrical manholes.
- I. For conduits carrying conductors rated 50 volts and below and where no ground connection is required. Termination bushings may be push-on, non-metallic, insulating

type as manufactured by Arlington Industries, Inc. Equivalent products by other manufacturers are acceptable.

- J. For conduits carrying conductors rated 50 volts and below where a ground connection is required provide termination bushings with insulated throats and integral grounding lugs.
- K. For conduits carrying conductors rated 51 volts and above. Termination bushings shall have insulated throats. Integral grounding lug shall be provided where required by code or required on the drawings and elsewhere in the specifications.

## 2.2 GALVANIZED RIGID CONDUIT (GRC) AND INTERMEDIATE METAL CONDUIT (IMC)

- A. Manufactured lengths, heavy wall, rigid steel conduit, protected inside and out by hot-dipped galvanized or electro-galvanized coating.
- B. Minimum conduit size shall be ½ inch.
- C. Connectors and couplings.
  - 1. Threaded.
  - 2. Liquid tight.

## 2.3 ELECTRICAL METALLIC TUBING (EMT)

- A. Standard lengths and size.
- B. Minimum conduit size shall be ½ inch.
- C. Connectors and couplings. Compression type. With steel bodies and steel nuts. (Cast fittings NOT acceptable).

## 2.4 POLYVINYL CHLORIDE CONDUIT (PVC)

- A. Standard lengths and sizes.
- B. Minimum size ½ inch with the exception that the minimum size conduit for underground site lighting circuits shall be 1 inch.
- C. Schedule 40 or 80, heavy wall rigid plastic (PVC) conduit manufactured to NEMA TC-2 standards, UL listed, and as required by NEC. Sunlight resistant.
- D. Rated for 90 degrees C. cable.
  - 1. Connectors and couplings.
  - 2. Schedule 40 or 80, to match conduit.
  - 3. Expansion Fittings: PVC material, Carlon series E945 or equivalent.
  - 4. Expansion Straps: PVC material, Carlon series E978 or equivalent.

## 2.5 PVC COATED RIGID METAL CONDUIT

- A. Galvanized rigid conduit with external coating of 40 mil (0.1 mm) thick polyvinyl chloride. 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.



- B. 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.

## 2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Galvanized spiral strip flexible steel.
- B. Standard conduit sizes.
- C. Heavy wall, sunlight resistant, PVC jacket.
- D. Minimum size ½ inch.
- E. Connectors and couplings.
  - 1. Liquid tight.
  - 2. Grounding type.
  - 3. Suitable for wet locations.
  - 4. Tapered threaded hub.
  - 5. Non-metallic materials.

## 2.7 FLEXIBLE METAL CONDUIT

- A. Galvanized spiral strip flexible steel.
- B. Standard conduit sizes.
- C. Minimum size ½ inch with the exception that 3/8 inch diameter may be used to serve individual lighting fixtures installed in a suspended accessible ceiling system.
- D. Connectors and couplings.
  - 1. Threaded.
  - 2. Grounding type.
  - 3. Insulated throat.
  - 4. Two screw clamp type with locknuts.
  - 5. Externally Secured.

## 2.8 EXPANSION FITTINGS

- A. Copper bonding jumper, Crouse-Hinds Type XJ.

## 2.9 EXPANSION/DEFLECTION FITTINGS

- A. Copper bonding jumper, Crouse-Hinds Type XD.

## 2.10 CONDUIT BODIES

- A. Galvanized or cadmium plated.
- B. Threaded hubs.
- C. Removable cover, with gasket.
- D. Corrosion-resistant screws.

## 2.11 SEALS

- A. Link Seal type as manufactured by Thunderline Corporation.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Requirements.

1. Seal conduits that run through different temperature or atmospheric conditions to prevent condensation or moisture from entering electrical equipment and devices.
2. Install wall entrance seal where conduits or direct burial conductors pass through foundation walls below grade.
3. Install conduit expansion fittings with bonding jumper in following locations:
  - a. Conduit runs which cross a structural expansion joint.
  - b. Conduit runs where movement perpendicular to axis of conduit may be encountered.
4. Locate junction boxes, conduit bodies, and other access covers so as to be accessible to electrical wiring.
5. Cut joints shall be square, reamed smooth, and drawn up tight.
6. Keep conduit plugged, clean, and dry during construction. Before wire pulling begins, pull cleaning plug through conduits to clear of dirt, oil, moisture, and other debris.
7. Install #12 AWG pull wire in empty conduit.
8. Cap spare conduits.
9. Route conduit runs above suspended acoustical ceilings so as not to interfere with ceiling tile removal.
10. Route conduits (including conduits routed above ceilings) parallel to or at right angles with lines of the building construction and structural members except conduit runs routed concealed in poured-in-place concrete floor slabs may be run in a direct line from source to load.
11. Make bends and offsets without kinking or destroying smooth bore of conduit. Arrange bends and offsets in parallel conduits to present a neat symmetrical appearance.
12. Conduit runs that extend through areas of different temperature or atmospheric conditions shall be sealed, drained, and installed in a manner that prevents drainage of condensed or entrapped moisture into cabinets, and equipment enclosures.
13. Conduits shall be routed at least 12" from parallel to steam lines, hot water pipes, flues, or high temperature piping or ducts shall not be closer than 12 inches and not be closer than 12 inches clear when crossing same.
14. Conduit shall not be routed over boiler, incinerator, or other high temperature equipment.
15. Where conduits must cross or follow the same path as water, steam or other fluid piping, electrical conduits shall be installed above, not below, piping.
16. Install bushings with ground lugs and integral plastic linings at equipment with open-bottom conduit entrances.
17. Feeder conduits shall contain only those conductors constituting a single feeder circuit.
18. Feeder conduits shall follow most accessible routes, concealed in construction in finished areas, exposed to the minimum temperature gradient and to minimum temperature fluctuation.

19. Feeder conduits shall not be routed in conduit floor slabs.
20. Confine feeder conduit to insulated portions of building, unless otherwise specified.
21. Trapped feeder conduit runs without facilities for continuous drainage are not acceptable.

### 3.2 CONDUIT LOCATION REQUIREMENTS

- A. Interior conduits for wiring systems rated 50 to 600 volts shall be electrical metallic tubing (EMT). Exceptions to the requirements stated above are as follows:
  1. Conduits in poured concrete construction shall be IMC or GRC regardless of size.
  2. Flexible conduit where required by other paragraphs in this section.
  3. Unless otherwise restricted by codes.
  4. Conduits installed in hazardous locations shall be GRC. See floor plans for hazardous locations.
  5. Conduits in corrosive locations shall be PVC coated GRC. See floor plans for corrosive locations.
  6. Conduits in security locations shall be IMC or GRC. See floor plans for security locations.
  7. Conduits in wet locations shall be IMC or GRC. See floor plans for areas to be treated as wet location.
- B. Interior conduits for wiring systems rated 0 to 50 volts shall be electrical metallic tubing (EMT). Exceptions to the requirements stated above are as follows:
  1. Conduits in poured concrete construction shall be IMC or GRC regardless of size.
  2. Flexible conduit where required by other paragraphs of this section.
  3. Unless otherwise restricted by codes.
  4. Conduits installed in hazardous locations shall be GRC. See floor plans for hazardous locations.
  5. Conduits in corrosive locations shall be PVC coated GRC. See floor plans for corrosive locations.
  6. Conduits in security locations shall be IMC or GRC. See floor plans for security locations.
  7. Conduits in wet locations shall be IMC or GRC. See floor plans for areas to be treated as wet location.
- C. Exterior underground conduits (conduits beyond the building footprint) in contact with the earth and shall be heavy wall schedule 40 PVC except where the conduits pass through the building walls. For conduit runs that pass through the building envelope horizontally and below grade, the first 5 feet of the run from the exterior face of the building wall below grade shall be galvanized rigid conduit. This requirement shall apply for conduits that exit building basement walls that are below the adjacent grade. Where conduits pass through poured concrete walls, the EC shall install metal sleeves prior to the walls being poured. Space between conduits and sleeves shall be sealed with interlocking rubber seals.
- D. Interior underground conduit runs are defined as those conduits in contact with the earth, below basement floor slabs or below slabs on grade, within the building footprint, where the runs penetrate the floor slabs vertically. These conduits shall be schedule 40 heavy wall PVC except as follows:
  1. Where specifically indicated otherwise on the plans.

2. Galvanized rigid conduit elbows shall be used where these conduit runs penetrate the floor slab so that there is no exposed PVC within the building.
  3. Conduit runs that exit the building vertically through a basement or grade level floor slab and then extend beyond the building footprint, transitioning to an exterior underground conduit run, are not required to be GRC for the 5 feet beyond where they cross the building footprint.
- E. Conduits embedded in concrete lighting fixture pole bases shall be galvanized rigid conduit.
- F. Conduits containing only electrical service bare copper grounding conductors shall be schedule 40 HW PVC.
- G. Conduit connections at motors, transformers, and other equipment that vibrates:
1. Flexible metal conduit between 18 inches and 3 feet long for conduit connections at equipment that vibrates.
  2. Liquid-tight flexible metal conduit where flexible connections are required and where conduit is exposed to moisture, dirt, fumes, oil, corrosive atmosphere. Locate so it is least subject to physical abuse. Corrosive areas are identified on the floor plans.
  3. Use double locknuts and insulated bushings with threads fully engaged.
- H. Conduit connections at ceiling recessed light fixtures. Provide flexible steel conduit whips between an independent junction box mounted above ceiling and the recessed ceiling mounted lighting fixtures. Allow for positioning of equipment to tile increments. Maximum length of whip shall be six feet.
- I. Conduits in electrical ductbanks shall be as specified in Section 26 05 43.
- J. Install conduct expansion fittings for all conduits crossing expansion joists.

### 3.3 BURIED UNDERGROUND CONDUIT

- A. Exterior underground buried conduits shall be buried at a depth of not less than 30 inches below grade.
- B. Provide conduits or ducts terminating below grade with means to prevent entry of dirt or moisture.
- C. Underground conduits shall slope 1/8 inch per foot for proper drainage. Conduits shall drain toward manholes and junction boxes, not the electrical equipment.
- D. Install wall entrance seal where conduits or direct burial conductors pass through foundation walls below grade.
- E. Provide a watertight conduit system where installed underground, or where embedded in concrete.

### 3.4 FLEXIBLE CONDUITS

- A. Install fittings designed for use with flexible liquid-tight conduit to ensure continuity of ground throughout the fittings and conduit and prevent entrance of moisture.

### 3.5 CONCEALMENT

- A. Unless specifically noted otherwise, conduits shall be routed concealed in finished spaces and shall not be visible at any point within the finished space or from the building's exterior. This requirement also applies to new conduits installed in existing construction.
- B. Exposed raceway may be used on remodeling projects only where physically impossible to route concealed in existing construction. In cases where exposed conduit is allowed it shall be equivalent to Wiremold 500 or 700 series as dictated by the wiring quantities. In each case the specific raceway type and routing shall be submitted to the Architect for approval. Where allowed, the general installation requirements are as follows:
  - 1. Raceways shall be routed horizontally along the corners of walls and ceilings, above edges of base molding at floors, or along the tops of window and door frames.
  - 2. Raceways shall be routed vertically along corners of adjacent walls and along the edges of window and door frames.
  - 3. Raceways shall not be routed down or across open wall surfaces except in portions of runs not exceeding 12 inches in length.
  - 4. Raceways shall be painted to match wall finishes. EC is responsible for painting of raceways.
  - 5. Fittings and boxes used with raceways shall be specifically designed and approved for use with the raceways.
- C. At the contractor's option, conduits may be installed concealed below basement floor slabs or below slabs on grade.
- D. Conduits may be routed exposed in mechanical equipment rooms and utility rooms.

### 3.6 SUPPORTS

- A. Raceways installed concealed in the stud space of hollow, stud and drywall partitions shall be fastened to steel studs with spring steel clips. Clips shall be utilized as intended by the manufacturer and installed per the manufacturer's instructions. Conduit supports utilizing tie wires shall not be used.
- B. Interior surface mounted conduits attached to walls:
  - 1. Raceways 1 ¼" diameter and smaller. One hole support straps.
  - 2. Raceways 1 ½" diameter and larger. Two hole straps.
  - 3. Light gauge steel framing fastened to wall surface with conduits fastened to steel framing using two piece conduit clamps.
- C. Interior surface mounted conduits attached to underside of structural ceilings and roofs:
  - 1. Two hole support straps.
  - 2. Light gauge steel framing fastened to ceiling surface with conduits fastened to steel framing using two piece conduit clamps.
  - 3. Where underside of roof structure consists of steel trusses, joists, beams, etc., spring steel clips for supporting raceways will be allowed. Clips shall be utilized as intended by the manufacturer and installed per the manufacturer's instructions.
- D. Interior conduit runs suspended from the underside of structural ceilings and roofs:
  - 1. Single Conduit Runs: Threaded rod fastened to structure with conduit attached to rod utilizing steel, yoke type support.

2. Multiple Conduit Runs: Horizontal light gauge steel framing suspended from structure with threaded rods, minimum two per frame, in a trapeze configuration. Conduits fastened to steel framing using two piece conduit clamps.
- E. Exterior, wall mounted, surface raceways. Cast zinc, one hole strap with back plate to stand raceway off wall surface 3/8" minimum.
- F. Provide riser clamps around conduits 1-1/4 inch or larger that are routed between floors.
- G. Conduits shall not be supported by, or attached to the suspension systems for dropped ceiling systems unless specifically detailed on the drawings.
- H. Secure conduits in place with malleable corrosion-proof alloy straps or hangers.
- I. The use of perforated strapping as a conduit hanging method is not acceptable.
- J. The use of tie wires to support conduits is not acceptable.

### 3.7 CONCRETE AND MASONRY CONSTRUCTION

- A. Conduits routed within poured concrete construction (poured walls, floor slabs, topping slabs) shall comply with the following requirements:
  1. Conduits shall be parallel to each other, spaced on center to center distance of at least three times conduit trade diameter, and provided with a minimum of 2 inches concrete covering. Contractor shall note that precast planks below topping slabs may camber with topping slab thickness less at the high point of the camber.
  2. Conduits larger than 1 1/4 inch diameter shall not be installed in floor slabs. Conduits over 3/4 inch diameter shall not be installed in topping slabs.
  3. Conduits embedded in a structural frame slab shall comply with applicable provisions of American Concrete Institute (ACI), Standard 318. Refer to structural drawings for locations of structural frames.
  4. Conduits used for feeders shall not be embedded in concrete floor slabs or concrete topping slabs.
  5. Conduits in poured concrete construction shall not cross other conduits or other piping.
  6. Unless specifically indicated on the electrical plans, conduits installed in poured concrete construction shall be approved by the Structural Engineer prior to conduit installation. Submit drawings showing conduit sizes and routings to the Architect for his review. Contractors who base their bid on the assumption that conduits are allowed in concrete construction do so at their own risk. No changes will be made to the contract if, during construction, the Structural Engineer prohibits the installation of conduit in concrete construction.
- B. In areas constructed of precast concrete conduits may be run in cores of planks.

### 3.8 FIRESTOPPING

- A. Provide firestopping at conduit penetrations through fire rated construction in accordance with Section 26 05 00.

### 3.9 CUTTING AND PATCHING

- A. Provisions for openings, holes, and clearances through walls, floors, ceilings, and partitions shall be made in advance of construction.
- B. Provide cutting, patching and painting necessary for the installation of electrical systems.
- C. Where conduits need to penetrate concrete or masonry construction install 22 gauge galvanized steel pipe sleeves, 1 inch larger in diameter than the conduit being installed. Sleeves shall extend 2 inches above the floor slab or wall penetrated. Install sleeves before walls or slabs are poured or constructed.
- D. Provide drawings indicating size and location of anticipated floor sleeves for the installation of electrical conduits.

### 3.10 ADJUSTMENT AND CLEANING

- A. Restore damaged areas on PVC jacketed, rigid conduit with spray type touch-up coating compound or as recommended by manufacturer.

### 3.11 CONDUIT SYSTEMS

- A. Where raceway systems are required, separate raceway systems shall be provided for each wiring system as follows:
  - 1. 208 volt normal power wiring systems.
  - 2. Fire alarm systems.
  - 3. Video surveillance systems.
  - 4. Electronic Card Key Access System
  - 5. Voice/data communications raceway systems.
  - 6. Wiring for card access systems.

END OF SECTION

This Page Intentionally Left Blank



## SECTION 26 05 33.1 - ELECTRICAL BOXES

### PART 1 - GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Applicable requirements of Division 0 and Division 1 shall govern work in this section.

#### 1.2 SCOPE

- A. Provide electrical boxes in accordance with this specification.

#### 1.3 RELATED WORK

- A. Section 26 05 33 - Conduits
- B. Section 26 05 19 - Low Voltage Wires, Cables and Connectors
- C. Section 26 27 26 - Wiring Devices
- D. Section 26 05 29 - Supporting Devices
- E. Section 26 05 26 - Grounding

#### 1.4 QUALITY ASSURANCE

- A. Reference Standards of the National Electrical Contractors Association (NECA), Standard of Installation.

### PART 2 - PART 2 - PRODUCTS

#### 2.1 INTERIOR WALL OUTLET BOXES - FLUSH MOUNTED

- A. Stamped steel, four inch square, 2-1/8" deep minimum, with square corners. Provide with raised device rings, height to match wall finish thickness. Mounting accessories. Larger width boxes shall be provided for ganging requirements indicated on plans.

#### 2.2 INTERIOR WALL OUTLET BOXES - SURFACE MOUNTED - DRY LOCATION

- A. Stamped steel, four-inch square, 2-1/8" deep, with round corners. Provide rounded corner raised box covers with openings for devices being installed. Refer to section 16111 for restrictions on exposed conduit systems.

#### 2.3 INTERIOR WALL OUTLET BOXES - SURFACE MOUNTED - DAMP OR WET LOCATION

- A. Cast malleable iron with threaded conduit hubs. Two inches deep minimum. Internal mounting ears. Boxes shall be coated with electroplated zinc, a dichromate coating, and an aluminum polymer enamel finish. Refer to Section 26 05 33 for restrictions on exposed conduit systems.

## 2.4 EXTERIOR WALL OUTLET BOXES - SURFACE MOUNTED

- A. Cast malleable iron with threaded conduit hubs. Two inches deep minimum. Internal mounting ears. Boxes shall be coated with electroplated zinc, a dichromate coating, and an aluminum polymer enamel finish. Refer to section 16111 for restrictions on exposed conduit systems.

## 2.5 SPECIAL BOXES

- A. Provide special boxes fabricated by the manufacturer of fixtures and other devices where standard outlets are not applicable.

## 2.6 GENERAL PURPOSE JUNCTION AND PULL BOXES

- A. Fabricate from code gauge galvanized steel, with covers held in place by corrosion resistant machine screws.
- B. Size shall conform to code requirements for number of conduits and conductors entering and leaving box.
- C. Provide with welded seams, where applicable, and equip with corrosion-resistant nuts, bolts, screws, and washers.
- D. Provide safety chain between cover and enclosure for boxes 24" or larger.
- E. Boxes to be sized per NEC 314.

## 2.7 WEATHERPROOF JUNCTION AND PULL BOXES

- A. Stainless steel or cadmium plated malleable iron cast type with threaded hubs, cast cover, and neoprene gasket.

## 2.8 BETWEEN STUD BOX SUPPORT BRACKETS

- A. Stamped and fabricated steel bracket designed to support 4" or 4-11/16" electrical boxes between wall studs.
- B. Manufactured by Erico, RBS series or equivalent.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install electrical boxes, in compliance with NEC requirements, in accordance with the manufacturer's written instructions and with recognized industry practices.
- B. Seal conduit at entrance to weatherproof boxes for interior and exterior locations exposed to weather or moisture.
- C. Install knockout closures to cap unused knockout holes where blanks have been removed.

- D. Locate boxes to provide access to electrical wiring. Relocate boxes rendered inaccessible by the installation of work by other trades.
- E. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry. Do not support from conduit.
- F. Set boxes, in concealed conduit runs, flush with wall surfaces, with or without covers.
- G. Do not install boxes back to back or through wall. Offset outlet boxes on opposite sides of wall a minimum 12 inches.
- H. Set outlet boxes parallel to construction, securely mounted and adjusted to set true and flush with the finished surface.
- I. Do not burn conduit holes, use knock-out punches, or hole saws.
- J. Use "no-bolt" studs where required.
- K. Use handy boxes only where specifically detailed on the drawings.
- L. Boxes shall be sized per code to accommodate the number and size of conduit entrances to the box and to accommodate the number of conductors, splices, fittings within the box. Do not use box extensions to create additional volume to meet NEC requirements for the number of conductors contained in a box.

### 3.2 EXPOSED OUTLET AND JUNCTION BOXES

- A. Install weatherproof outlet and junction boxes outdoors and in areas where drawings show weatherproof (WP) wiring devices.

### 3.3 INTERIOR OUTLET BOX ACCESSORIES

- A. Provide outlet box accessories for each installation, including but not limited to: mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes. Accessories shall be compatible with outlet boxes being used and meeting requirements of individual wiring situations.

### 3.4 LIGHTING FIXTURE OUTLET BOXES

- A. Securely mount with bar type hangers spanning structural members to support weight of fixture.
- B. Do not support from conduit.
- C. Equip with 3/8 inch fixture studs and tapped fixture ears, for surface mounted or pendant mounted lighting fixtures. Fixture studs shall be provided for mounting of lighting fixtures exceeding 25 lbs. in weight. Fixture studs shall be attached through knockouts at the top of the box.
- D. Provide additional attachments from structure for outlet boxes supporting lighting fixtures weighing in excess of 25 lb.

### 3.5 OUTLET BOX LOCATIONS

- A. Locate flush mounted wall boxes in corner of nearest brick or block to keep cutting to a minimum.
- B. Location of outlets and equipment as shown on drawings is approximate, and exact location is to be verified and shall be determined by:
  - 1. Construction or code requirements.
  - 2. Conflict with equipment of other trades.
  - 3. Equipment manufacturer's drawings.
- C. Where receptacles and communications outlets are shown grouped next to each other on the drawings, the boxes for these outlets shall be mounted next to each other and shall not be located according to stud spacings. The Contractor shall utilize between stud box supports to assist in mounting boxes proximal to one another on a consistent spacing between wall studs.
- D. Minor modification in the location of outlets and equipment is considered incidental up to a distance of 10 feet, provided the change in location is requested prior to rough-in.
- E. Mounting heights for devices and equipment to be measured from finished floor to centerline of device.

END OF SECTION

## SECTION 26 24 16 - ELECTRICAL PANELBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Applicable requirements of Division 0 and Division 1 shall govern work in this section.

#### 1.2 SCOPE

- A. Provide panelboards as shown on the drawings and as specified herein.

#### 1.3 RELATED WORK

- A. Section 26 05 00 - General Electrical Provisions
- B. Section 26 28 00 - Low Voltage Overcurrent Protective Devices
- C. Plans - Panel Schedule

#### 1.4 SUBMITTALS

- A. Shop drawings.
  - 1. Cabinet dimensions, nameplate nomenclature, electrical ratings, and breaker type listing.
  - 2. Product data sheets with installation instructions.
- B. Operating and Maintenance manuals.
  - 1. Field quality control test results.
  - 2. Operating and maintenance data.

#### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Do not store panelboards exposed to weather.
- B. Protect panelboards against damage from work of other trades.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Use of a manufacturer's name and model or catalog number is for the purpose of establishing standard of quality and general configuration desired:
  - 1. Square D, Eaton/Cutler-Hammer, General Electric, Siemens and Bussmann.

#### 2.2 PANELBOARD UL LISTED SHORT CIRCUIT INTEGRAL EQUIPMENT RATINGS

- A. 120/240V panelboards. 22,000 RMS symmetrical amperes minimum or as shown on drawings. Equivalent to Square D type NQOD.

## 2.3 PANELBOARD CONSTRUCTION

- A. Main breaker or main lugs only, per panelboard schedule.

## 2.4 BUSSING

- A. Plated copper phase bussing.
- B. Plated copper neutral bus with terminals.
- C. Copper equipment grounding bus with terminals.
- D. Distributed phase sequence type.
- E. Ratings per panelboard schedule, 100-amp minimum.

## 2.5 PANEL CABINETS

- A. Code gauge galvanized steel.
- B. Minimum 20" wide.
- C. Minimum 5¾" deep.
- D. Height as required to accommodate breakers and spaces indicated on plans and code required gutter space.
- E. Gutters adequate for wire size used, 4" minimum.

## 2.6 PANEL FRONTS

- A. Dead front safety type.
- B. Concealed adjustable trim clamps.
- C. Code gauge steel with rust inhibiting primer and baked enamel finish. Cover thickness shall not be less than the requirements indicated the listing for UL 50.
- D. Panel front cover shall have piano hinge to allow access to wiring gutters with out removal of panel trim. Hinged trim held in place with screw fasteners. Door shall be built into trim which allows access to breakers as well as to hinged trim screw fasteners. Breaker access door shall have the following features:
  - 1. Concealed piano hinge.
  - 2. Flush stainless steel cylinder tumbler type locks with spring loaded door pulls.
  - 3. Locks for all job panels keyed alike.
- E. Steel frame circuit directory holder with directory cards on inside face:
  - 1. Clear plastic cover.
  - 2. Typewritten descriptions.

## 2.7 BREAKER BRANCH PANELBOARDS

- A. Conform to Section 26 28 00.
- B. UL Class A ground fault circuit protection (GFI) as shown on drawings.

- C. UL listed terminals for type and temperature rating of wire utilized. Anti-turn solderless type.
- D. Circuit breaker construction for NQOD and NEHB panels shall bolt on to panel bussing.
- E. Circuit breaker construction for I-Line panels shall plug on to panel bussing but breaker cases shall bolt to panel cabinet.

## 2.8 NAMEPLATES

- A. Engraved laminated plastic type.
- B. Letters  $\frac{3}{16}$ " high.
- C. White letters on black background.
- D. Verify panelboard designation with the owner's representative.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Examine area to receive panelboard to assure adequate clearance for panelboard installation.
- B. Monitor construction of other trades so that no material is installed over the top or in front of the switchboard in violation of code required working clearances.
- C. Start work only after unsatisfactory conditions are corrected.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.
- B. Flush mount, surface mount, install on equipment rack or in MCC as specified on drawings and schedules.
- C. Support panel cabinets independently to structure with no weight bearing on conduits.
- D. Install recessed panelboards to allow cover to be drawn tight against wall to provide neat appearance. Verify wall thickness to accommodate panel depth.
- E. Install panelboards so top breaker is not higher than 6 ft-0 in. above floor.
- F. Adjacent panel cabinets shall be of same size and mounted in horizontal alignment.
- G. Install in each panelboard a typewritten directory accurately indicating rooms and equipment being served.

- H. Attach nameplates. Nameplates for panels in public areas shall be attached to the inside face of the cover. Nameplates for panels in equipment rooms and other non-public areas shall be attached to the outside face of the cover.
- I. Provide (2) one inch spare branch conduits for flush panelboards. Conduits shall be provided between panel cabinet and accessible ceiling plenum.

### 3.3 FIELD QUALITY CONTROL

- A. Balance load among feeder conductors.
- B. Unbalance shall not exceed  $\pm 7\frac{1}{2}\%$  of computed average load per phase.
- C. Energize each circuit and check for correct function.

### 3.4 ADJUSTMENT AND CLEANING

- A. Adjust doors and operating mechanisms for free mechanical movement.
- B. Tighten lugs and bus connections.
- C. Thoroughly clean enclosure inside and outside of dust and debris before final acceptance.
- D. Sand, prime and paint scratched or marred surfaces to match original finish.

END OF SECTION



## SECTION 26 27 26 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Applicable requirements of Division 0 and Division 1 shall govern work in this section.

#### 1.2 SCOPE

- A. Provide wiring devices generally consisting of switches and receptacles on the drawings and as specified herein.

#### 1.3 RELATED WORK

- A. Section 26 05 33.1 - Electrical Boxes

#### 1.4 SHOP DRAWING SUBMITTALS

- A. Listing of brand names and types of materials proposed for use.
- B. Nameplate nomenclature.
- C. Electrical ratings.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Use of a manufacturer's name and model or catalog number is for purpose of establishing standard of quality and general configuration desired only:
  - 1. Cooper Wiring Devices
  - 2. Hubbell Wiring Device Div.
  - 3. Pass and Seymour, Inc.
  - 4. Crouse-Hinds
  - 5. Leviton
  - 6. General Electric
  - 7. Lutron (Wall Box Dimmers)

#### 2.2 GENERAL

- A. Provide factory-fabricated, NEMA specification grade wiring devices in type, color, and electrical rating for service indicated.
- B. Provide wiring devices of one manufacturer.
- C. Wiring devices for use with stranded conductor shall have a clamping type terminal that can be physically tightened. The clamping device shall not be a spring type of clamp.

#### 2.3 TOGGLE SWITCHES

- A. GENERAL USE LIGHTING SWITCHES
  - 1. 20 amp toggle type. Pass and Seymour Cat. No. 20AC1-I (Ivory). Switches controlling emergency circuits shall be red.

2. Switches controlling equipment, the operation of which is not evident from the switch position, shall include flush neon pilot light in conjunction with proper switch. Each switch shall include engraved plate to identify equipment being controlled. (White letters on black, 1/8 in. high minimum.) Provide a two- gang switch plate. Mount toggle switch in one opening, red neon pilot light in the other. Light shall be Pass and Seymour Cat. No. 2151RED or equivalent.

## 2.4 RECEPTACLES

- A. All receptacles shall be extra heavy duty grade receptacles.
- B. GENERAL USE DUPLEX RECEPTACLES
  1. NEMA type 5-20R, grounding type, 20 amp, 120 volt rating. Pass and Seymour Cat. No. 5262-I. Receptacle color shall be red where served from an emergency circuit.
  2. Where a single duplex receptacle is wired to a dedicated 20 ampere, 120 volt circuit, provide NEMA type 5-20R grounding type 20 ampere receptacles. Pass and Seymour Cat. No. 5362-I.
- C. SPECIAL PURPOSE RECEPTACLES
  1. As shown on drawings and schedules.
- D. GROUND FAULT CIRCUIT INTERRUPTER DUPLEX RECEPTACLES
  1. Leviton model number 7899-I with LED indicator light. Device must meet UL year 2003 listing requirements for GFCI receptacles.
- E. DAMP AND WET LOCATIONS
  1. All 15 and 20A 125 and 250 volt receptacles shall be listed "weather resistant type (WR)" per NEC 406.8.

## 2.5 WIRING DEVICE PLATES AND COVERS

- A. Provide wall plates for wiring devices, with ganging, cutouts and metal screws for securing plates to devices. Screw heads colored to match finish of plate.
- B. Plates for flush mounted devices shall be of thermoplastic nylon, non-combustible, mar-proof thermosetting material, minimum 0.100" thick. Color of plates shall be of ivory except that color shall be red for devices associated with emergency circuits.
- C. Plates for surface mounted Type FS or FD boxes: Type FSK galvanized steel covers.
- D. Plates for surface mounted 4 inch square boxes: 1/2 inch raised galvanized steel covers.
- E. Weatherproof plates and covers for exterior wiring devices or devices in damp locations. Devices required to be weatherproof are identified on the plans.
  1. Clearly marked "suitable for wet locations while in use". NEMA 3R rated while in use.
  2. Cover shall be flame retardant, UV stabilized polycarbonate, non-conductive.
  3. Battleship gray finish.
  4. Cover shall extend approximately 2 1/2" from wall surface.
  5. Gasket between cover and wall.
  6. Mount so that cord ports are located at the bottom of the cover.
  7. Provide with tumbler lock.
  8. Stainless steel mounting screws.
  9. Covers as manufactured by TayMac Corporation or equivalent.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Examine areas and conditions under which wiring devices are to be installed and notify Engineer, in writing, of conditions detrimental to proper and timely completion of work.
- B. Do not proceed with work until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.
- B. Do not install devices until after wall finishes (wall covering, painting, wallpaper,) have been applied. Outlets installed prior to walls being finished and used for construction power shall be replaced at the time of substantial completion.
- C. Before installing receptacles and switches, clean electrical boxes of dirt and debris.
- D. Do not use terminals on wiring devices (hot or neutral) for feed-through connections, looped or otherwise. Make circuit connections via wire connectors and pigtails.
- E. Install gasket plates for devices or system components having light emitting features, as switches with pilot lights. Where installed on rough textured surfaces, seal plates with black self-adhesive poly-foam.
- F. Ground receptacles with an insulated green ground wire from device ground screw to a bolted outlet box connection. Route a continuous green equipment grounding conductor with branch circuit conductors serving isolated ground receptacles. Terminate the equipment ground on the ground bus in panelboards.
- G. Install emergency switches which occur adjacent to normal light switches in separate boxes to maintain systems isolation in accordance with the NEC. Provide red wiring devices and coverplates for devices wired to emergency power circuits.
- H. Stranded conductor terminating on wiring devices shall be terminated in a clamping terminal and not on the screw terminal.
- I. Provide a layer of electrical tape around the perimeter sides of each wiring device so that the terminations are insulated.
- J. Where GFI protected receptacles are indicated on the plans, each receptacle indicated shall be a GFI receptacle. Standard receptacles protected with an upstream GFI receptacle are not permitted.

### 3.3 FIELD QUALITY CONTROL

- A. Provide operational testing for all devices.
- B. Test receptacles with Hubbell 5200, Woodhead 1750, or equal, for correct polarity, proper ground connection, and wiring faults.

END OF SECTION

## SECTION 26 27 27 - OCCUPANCY SENSORS

### PART 1 - GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Applicable requirements of Division 00 and Division 01 shall govern work in this section.

#### 1.2 SCOPE

- A. Provide occupancy sensors for the automatic control of the lighting in building spaces as shown on the drawings and as specified herein.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Watt Stopper,
- B. Hubbell/Unenco ,
- C. Sensor Switch.
- D. Listing of a manufacturer does not guarantee approval. Manufacturers must meet requirements listed below to be considered acceptable.
- E. All occupancy sensors shall be hardwired type; battery type shall not be permitted. All devices shall be WHITE

#### 2.2 WALL MOUNTED (WALL SWITCH TYPE)

- A. The sensor shall use either passive infrared or, if dual technology, passive infrared and passive acoustic sensing for detecting room occupancy. The unit shall fit in/on a standard single gang switch box and require only two wires and a grounded box for operation.
- B. Rated capacity: 600 watts minimum at 120 volts, 60 Hz; 1000 watts minimum at 277 volts, 60 Hz
- C. Sensitivity shall be user adjustable or self adjusting type.
- D. The delay timer shall be adjusted 20 minutes by the contractor in the field. The sensor shall have a test mode for performance testing.
- E. The off switch shall have manual override for positive off and automatic on.
- F. The test LED shall indicate motion.
- G. The area of coverage shall be approximately 180 degrees by 35-40 feet.
- H. The unit shall have a five year warranty.

## 2.3 CEILING MOUNTED (REFER TO SYMBOL LIST FOR PLAN DESIGNATIONS)

- A. The sensor shall use either ultrasonic or, if dual technology, passive infrared and passive acoustic sensing or ultrasonic technology for detecting room occupancy. The unit shall fit in/on a standard octagon box.
- B. Ceiling mounted sensor shall have built-in photocell/daylight override option to keep lights off if enough ambient light is present – refer to symbol list on the plans.
- C. Sensing device may be separate from switching relay. Switching relay shall include control power transformer. Power transformer/switching relays are not shown on plans. Provide in quantities as required and locate above accessible ceilings near sensing device. Relay contacts shall have a rated capacity of 20 amps at 120 or 277 volts, for fluorescent lamps.
- D. Sensitivity shall be user adjustable or self adjusting type.
- E. The delay timer shall be adjusted to 20 minutes by the contractor in the field. The sensor shall have a test mode for performance testing.
- F. The coverage area shall be 360 degrees by approximately 25 feet radius when mounted at 9 foot height (for ultrasonic technology) or 20' height (for dual technology sensors)
- G. The sensor shall have provisions, such as masking, to block out problem areas.
- H. Occupancy sensors shall have an auxiliary normally open contact to tie in to the building automation system for indication of the space being occupied or unoccupied. The contact should fail closed for occupied mode
- I. Sensitivity and time delay settings shall be initially set for maximum sensitivity and longest time delay.
- J. Test LED to indicate motion.
- K. The unit shall have a five year warranty.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Occupancy sensors are to control the lighting fixtures in the rooms shown on the drawings. Adjust the sensitivity to reduce nuisance operation.
- B. Low voltage wiring for this system may be installed exposed above accessible ceilings or in wall cavities. Cable installed in return plenum areas shall be plenum rated. Exposed cable shall be supported at 5 foot minimum intervals using bridal clamps or tie wraps.
- C. Ceiling mounted occupancy sensors and adjustable wall mounted occupancy sensors have circuit switching relay packs that are separate from the sensors. These relay packs are not shown on the floor plans. They are to be located above accessible ceilings in the areas served and are to be provided in the quantities required to achieve the control requirements indicated on the floor plans.

END OF SECTION

This Page Intentionally Left Blank



## SECTION 26 27 28 - MOTOR AND CIRCUIT DISCONNECTS

### PART 1 - GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Applicable requirements of Division 0 and Division 1 shall govern work in this section.

#### 1.2 SCOPE

- A. Provide disconnect switches for the disconnection of motorized equipment and other equipment required by the national and state electrical codes and as specified herein. Code required disconnects shall be provided for all equipment unless included with equipment provided by others. Verify requirements with other trades.

#### 1.3 RELATED WORK

- A. Section 26 05 26 - Grounding
- B. Section 26 28 00 - Low Voltage Overcurrent Protective Devices
- C. Section 26 05 19.4 - Motor Wiring
- D. Section 26 29 00 - Motor Starters

#### 1.4 SHOP DRAWING SUBMITTALS

- A. Enclosure dimensions, nameplate nomenclature, electrical ratings, and fuse and breaker type listing.

#### 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Do not store exposed to weather.
- B. Protect against damage from work of other trades.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. General Electric, Siemens, Square D, Eaton/Cutler-Hammer.

#### 2.2 DISCONNECT RATINGS

- A. UL listed short circuit rating. 200,000 RMS amps with Class R fuses.

#### 2.3 SAFETY SWITCH CONSTRUCTION

- A. Twenty amp, one pole, non-fusible.
  - 1. Toggle type operator.
  - 2. Toggle guard capable of locking switch in the on or off position.
  - 3. Rated 1HP at 120 volts AC.
- B. Switches for 250 volt or 600 volt equipment

1. NEMA heavy duty Type HD.
2. Horsepower rated or as indicated on drawings
3. Dual cover interlock.
4. Visible blades.
5. Provisions for control circuit interlock.
6. Pin type hinges.
7. Tin plated copper current carrying parts.
8. Quick make and break operator mechanism.
9. Handle attached to box, not cover.
10. Handle position indication, ON in up position and OFF in down position.
11. Padlock provisions for up to three padlocks in OFF position.
12. UL listed lugs for type and size of wire specified.
13. Spring reinforced fuse clips for Type R fuses where fusible disconnect is indicated or required.
14. Provisions for insulated neutral.
15. Disconnect feeder grounding kit.
16. Service listed.

#### 2.4 ENCLOSURED CIRCUIT BREAKER CONSTRUCTION

- A. Dual cover interlock.
- B. External trip indication.
- C. Provisions for control circuit interlock.
- D. Padlock provisions for up to three padlocks in OFF position.
- E. Handle attached to box, not cover.
- F. Handle position indicates ON, OFF, or TRIPPED.
- G. Provisions for insulated or grounded neutral.

#### 2.5 ENCLOSURES

- A. Indoor. NEMA 1 code gauge steel with rust inhibiting primer and baked enamel finish.
- B. Outdoor. NEMA 3R code gauge zinc coated steel with baked enamel finish or NEMA 4 when indicated on drawings.
- C. Corrosive Areas and Kitchen Spaces. NEMA 4X Type 304 stainless steel with brushed finish.

#### 2.6 NAMEPLATES

- A. Engraved laminated plastic type. Identify specific name of equipment served.
- B. Letters 3/16" high.
- C. White letters on black background.
- D. Identify per equipment controlled.

## 2.7 SPARE FUSES

- A. Furnish owner with our complete set (3) of spare fuses each with each size or type (e.g. Fen,30A,45A etc.)
- B. Provide spare fuse enclosure sized for single fuses. Locate in Electrical room.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Provide disconnect switches for loads required by code. Review HVAC and Plumbing specifications to determine what equipment is furnished with disconnect switches. Install disconnect switches whether furnished under this contract or not. It is the Electrical Contractor's responsibility to determine the need for a disconnect switch requirements for each specific load. The contractors shall include in their bid code required disconnect switches whether indicated on the drawings or not.
- B. Provide label on inside of disconnect cover identifying the types of fuses to be used.

### 3.2 GROUNDING

- A. If disconnect concentric knockouts are used, the contractor shall provide a grounding bushing or other means to insure ground continuity. Concentric knockouts are not listed for grounding continuity.
- B. If disconnect is utilized as service disconnect. Provide service grounding kit, label as service disconnect and provide UL Listing for service disconnect.

### 3.3 INSPECTION

- A. Examine area to receive disconnect for adequate clearance for installation.
- B. Start work only after unsatisfactory conditions are corrected.

### 3.4 INSTALLATION

- A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.
- B. Locate disconnect switches as shown on drawings or required by NEC.
- C. Install on equipment support where feasible, or anchor firmly to wall or structural surface.
- D. Provide control circuit interlock required by NEC.

### 3.5 ADJUSTMENT

- A. Adjust covers and operating mechanism for free mechanical movement.
- B. Verify overcurrent protection to provide proper operation and compliance with NEC.

- C. Tighten wire and cable connections.
- D. Thoroughly clean enclosure inside and outside of dust and debris before final acceptance.
- E. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

## SECTION 26 28 00 - LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Applicable requirements of Division 00 and Division 01 shall govern work in this section.

#### 1.2 SCOPE

- A. Provide overcurrent devices of the sizes and interrupting ratings as shown on the drawings and as specified herein.

#### 1.3 RELATED WORK AND REQUIREMENTS

- A. Section 26 24 16 - Electrical Panelboards
- B. Section 26 29 00 - Motor Starters
- C. Section 26 05 04 – Inspection and Testing of Electrical Equipment

#### 1.4 SUBMITTALS

##### A. SHOP DRAWINGS

1. Device dimensions, nameplate nomenclature and electrical ratings.
2. Product data sheets with installation instructions.
3. Time current characteristics curves for each size and type of device.

##### B. OPERATING AND MAINTENANCE DATA

1. As specified in Section 26 05 00.
2. Manufacturer's instructions for replacing parts, performing cleaning, and operating and maintaining circuit breakers.
3. Repair parts lists.

##### C. TEST REPORTS

1. Report of field tests.
2. Record of circuit breaker settings.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

##### A. FUSES

1. Bussmann, Gould Shawmut, and Little Fuse

##### B. MOLDED CASE CIRCUIT BREAKERS

1. Square D, Eaton/Cutler-Hammer, Siemens, and General Electric.

## 2.2 250 VOLT FUSE TYPES

- A. Class RK-1, one end rejection or to fit mountings specified. 0-600 ampere, 200,000 ampere interrupting rating. Equivalent to Bussmann Low-Peak. LPN-R, dual element, time delay with short circuit protection for motor, transformer, welder, feeder and main service protection.

## 2.3 SPARE FUSES

- A. Provide 100% spare (minimum of three) of each type and rating of installed fuses.
- B. Copy 26 27 28 2.07B.

## 2.4 PANELBOARD CIRCUIT BREAKERS

- A. Thermal and magnetic protection.
- B. Single-handle common trip, two and three poles (handle ties not acceptable).
- C. Bolt-on type.
- D. Quick make and break toggle action.
- E. Handle trip indication.
- F. Handle position indication, ON in up position, OFF in down position, and TRIPPED centered.
- G. UL listed for type and temperature rating of wire specified.
- H. UL listed short circuit rating (integrated equipment rating):
  - 1. Up to 240V: 10,000 RMS symmetrical amperes minimum.
  - 2. Up to 480V: 14,000 RMS symmetrical amperes minimum.
- I. UL SWDL switching duty on 120V circuits where loads are panel switched.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.
- B. Overcurrent protection devices by same manufacturer.
- C. Circuit breakers shall be factory installed in enclosures.
- D. Verify all breakers are tightened to manufactures recommended torque values.
- E. Fuses shall not be installed until equipment is ready to be energized.

### 3.2 ADJUSTMENT

- A. Adjustable settings on circuit breakers shall be set to provide selective coordination, proper operation and compliance with NEC. Follow manufacturer's recommendations and set all breakers as required

### 3.3 FIELD QUALITY CONTROL

- A. Test and permanently record the following:
  - 1. Fuses.
  - 2. Equipment nameplate requirement.
  - 3. Actual fuse rating.
- B. Circuit Breakers:
  - 1. Nameplate data.
  - 2. Actual trip setting.

END OF SECTION

This Page Intentionally Left Blank



## SECTION 26 29 00 - MOTOR STARTERS

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. The work under this section includes manual motor starters, magnetic motor starters, combination magnetic motor starters and motor control centers.

#### 1.2 RELATED WORK

- A. Applicable provisions of Division 1 shall govern work under this Section.
  - 1. Section 26 05 19 - Low Voltage Wires, Cables and Connectors
  - 2. Section 26 28 13 - Low Voltage Overcurrent Protective Devices
  - 3. Section 26 05 19.4 – Motor Wiring
  - 4. Section 26 01 26 - Electrical System Testing
  - 5. Section 26 05 29 –Supporting Devices.

#### 1.3 COORDINATION WITH OTHER TRADES

- A. Motors:
  - 1. 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.
  - 2. All motors shall conform to the following description unless otherwise noted or required.
  - 3. Motors 1/2 HP and smaller shall be wound for operation on single phase, 120V, 60 Hz. service unless otherwise noted.
  - 4. Motors 3/4 HP and above shall be wound for operation on 1 phase, 60 Hz, 240V service unless otherwise noted.
  - 5. Refer to drawings in each case in order to verify voltage characteristics required.
- B. Equipment:
  - 1. 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.
  - 2. The starters for these motors shall be furnished and installed by the Electrical Trade unless noted otherwise.
  - 3. 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.
- C. Wiring Connections:
  - 1. Furnish branch circuits for all motors to the starting equipment and then to the motors, complete with all control wiring for automatic and remote control where required or noted. Conduits to motors shall terminate in the conduit fittings on the motors, the final connection being made with liquid-tight flexible, non metal conduit. Conductors between starter/VFD and motor shall be XHHW.

2. Provide all necessary labor and material to completely connect all electrical motors and controls (where required) in connection with the building utility equipment, including fans, pumps, overhead door operators, etc.
3. All conduits and wiring required for control work from the holding coil circuit of the starter, including the furnishing and installation of control devices such as auxiliary contacts, control relays, time delay relays, pilot lights, selector switches, alternators, etc., shall be provided and installed by other trades unless otherwise indicated.

D. Power Branch Circuits:

1. Wire sizes for branch circuits not specifically called for on drawings or in specifications shall be based on 125 percent of the full load current of the motor unless the voltage drop of motor branch circuits exceeds 1-1/2 percent from the distribution panel to the motor; in which case, voltage drop shall govern wire sizes. A power factor of 80 percent shall be used for motors in such calculations.

1.4 REFERENCES

- A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- B. ANSI/UL 198E - Class R Fuses.
- C. NEMA AB 1 - Molded Case Circuit Breakers.
- D. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- E. NEMA KS 1 - Enclosed Switches.
- F. NEMA PB 1 - Panelboards.
- G. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

1.5 SUBMITTALS

- A. 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.
- B. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.
- C. Submittal shall include a schedule that lists which starter, by model number, is intended to be provided for each motor with tag number for proposed use.

1.6 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section 16010 GENERAL REQUIREMENTS.
- B. Manufacturer's printed instructions for replacing parts, performing cleaning and operating and maintaining motor starters.

- C. Repair parts list.
- D. Field quality control test results.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. 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.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

#### 1.8 SPARE PARTS

- A. Keys: Furnish two (2) each to Owner.
- B. Provide three (3) spares of each size and type fuse used. Provide enclosure for spare fuses.
- C. Fuse Pullers: Furnish one fuse puller to Owner.
- D. Provide space fuse enclosure sized for single fuses. Locate in Electrical Room.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Allen Bradley, Cutler-Hammer/Westinghouse/Eaton, Square D, General Electric, and Siemens.
- B. Starters shall be by one manufacturer

#### 2.2 MANUAL MOTOR STARTERS

- A. Manual Motor Starter: NEMA ICS 2; size as shown on Drawings. AC general-purpose Class A manually operated full-voltage controller for induction motors rated in horsepower, with overload protection, red (Run) pilot light and toggle operator.
- B. Starter inoperative, unless thermal unit is in position.
- C. Provisions for resetting starter after overloads trip the starter.
- D. Enclosure: NEMA Type: As indicated on the drawings.
- E. Provide manufacturer's equipment ground kit in all starter enclosures.

#### 2.3 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower; size 00 minimum.
- B. Full Voltage Starting: Non-reversing type.

- C. Reduced Voltage Starting: Solid-state type, trip current rating shall be adjustable. The overload shall be self-powered, provide phase loss and phase unbalance protection, have a permanent tamper guard and be ambient insensitive. The overload shall have a mechanical test function.
  - D. Make sure specifications and drawings for two (2) speed motors (single winding or double (2) windings) match mechanical specifications. Provide information in motor schedule on what type of 2-speed starter and six (6) pole disconnect is required.
  - E. Size: NEMA ICS 2; size as shown on Drawings, size 0 minimum.
  - F. Coil Operating Voltage: 120 volts, 60 Hz.
  - G. Overload Protection: bimetal or melting alloy.
  - H. Starter inoperative, unless thermal unit is in position.
  - I. Provisions for resetting starter after overloads trip the starter.
  - J. Enclosure: NEMA Type: As indicated on the drawings.
  - K. Provide manufacturer's equipment ground kit in all starter enclosures.
  - L. Auxiliary Contacts: NEMA ICS 2; two[\_\_\_\_\_] field convertible NO/NC contacts in addition to seal-in contact.
  - M. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO, in front cover.
  - N. Indicating Lights: NEMA ICS 2; LED Push-to-test type. RUN: red in front cover.
  - O. Indicate on the Drawings the requirement for on-time delay relays for motors (10 HP and larger) connected to emergency generators.
  - P. Relays: NEMA ICS 2; Provide on-time delay (0-60 sec) relays as indicated on the Drawings.
  - Q. Provide phase loss protection relay with each motor starter, with contacts to de-energize each motor starter.
  - R. Control Power Transformers: Each magnetic starter shall have a dual fused primary and a single fused 120Vsecondary control transformer, sized for the load, 100 VA minimum. Additionally, the X2 terminal of the control transformer shall be grounded.
  - S. Combination Motor Starters: Combine motor starters with fusible switch disconnect in common enclosure.
  - T. Select the proper disconnecting means to match the above paragraph.
- 2.4 CONTROLLER OVERCURRENT PROTECTION AND DISCONNECTING MEANS
- A. NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

- B. Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class R fuses.
- C. Disconnects shall include provision for padlocking in the "off" position.

## 2.5 FUSES

- A. Fuses 600 Amperes and Less: Dual element, time delay, 250 volt, UL Class RK 5. Interrupting Rating: 200,000 rms amperes.

## 2.6 NAMEPLATES

- A. Engraved laminated plastic.
- B. Letters 3/16" high.
- C. White letters on black background.
- D. Identify motors as to load served not motor numbers.

# PART 3 - EXECUTION

## 3.1 INSPECTION

- A. Examine area to receive motor starter for adequate clearance for motor starter installation.
- B. Start work only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized practices.
- B. Install on equipment rack, in MCC, or mounted firmly to wall of structural surface. Refer to plumbing plans or heating, ventilating and air conditioning plans for starter locations.
- C. Select and install heater elements in motor starters to match installed motor characteristics.
- D. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

## 3.3 FIELD QUALITY CONTROL

- A. Megger check of phase-to-phase and phase-to-ground insulation levels.
- B. Do not megger check solid state equipment.

- C. Test for continuity between line and load terminals and between control terminals.
- D. Operational check.
- E. Test each motor and permanently record following information:
  - 1. Motor identification as to the load served.
  - 2. Nameplate data.
  - 3. Overload relay equipment.
  - 4. Protective relay setting.
  - 5. Voltage and current phase readings.
  - 6. Direction of rotation.

#### 3.4 ADJUSTMENT AND CLEANING

- A. Adjust covers and operating mechanisms for free mechanical movement.
- B. Tighten wire and cable connections.
- C. Verify over current protection thermal unit size with motor nameplate to provide proper operation and compliance with NEC.
- D. Clean interior of enclosure.
- E. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

## SECTION 26 31 11 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 REFERENCE CODES AND LISTINGS

- A. National Fire Protection Association (NFPA) – The latest adopted edition of the code referenced:
  - 1. NFPA 1 – National Fire Code
  - 2. NFPA 13 – Standard for the Installation of Sprinkler Systems
  - 3. NFPA 70 – National Electrical Code
  - 4. NFPA 72 – National Fire Alarm Code
  - 5. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems
  - 6. NFPA 101 – Life Safety Code
- B. Federal Guidelines for Accessibility for Americans with Disabilities
- C. Approval from the Office of the State Fire Marshall.
- D. The system as a whole and the individual system components shall comply with applicable listings of Underwriter's Laboratories (UL), including but not limited to the following.
  - 1. UL864/UOJZ, APOU – Control Units for Fire Protective Signaling Systems
  - 2. UL 268A – Smoke Detectors for Fire Protective Signaling Systems
  - 3. UL268A – Smoke Detectors for Duct Applications
  - 4. UL 464 – Audible Signaling Appliances
  - 5. UL 1638 – Visual Signaling Appliances
  - 6. UL 38 – Manually Activated Signaling Boxes
  - 7. UL 346 – Water flow Indicators for Fire Protective Signaling Systems
  - 8. UL 1971 – Standard for Signaling Devices for the Hearing Impaired
  - 9. UL 1481 – Power Supplies for Fire Protective Signaling Systems
  - 10. UL 521 – Heat Detectors for Fire Protective Systems

#### 1.3 SUMMARY

- A. Section Includes:
  - 1. Fire-alarm control unit.
  - 2. Manual fire alarm pullstations.
  - 3. System smoke detectors.
  - 4. Notification devices.
  - 5. Remote annunciator.
  - 6. Air handling system shutdown relays
  - 7. Addressable interface devices
  - 8. Water flow detector pressure switches
  - 9. Sprinkler supervisory switches
  - 10. Digital alarm communicator transmitter.

- B. Related Sections include the following:
  - 1. Division 26 Section "Low-Voltage Electrical Power Conductors and Cables"
  - 2. Division 26 Section "Grounding and Bonding for Electrical Systems"
  - 3. Division 26 Section "Raceways and Boxes for Electrical Systems"

#### 1.4 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

#### 1.5 SYSTEM DESCRIPTION

- A. Furnish and install a complete UL certified, non-coded, point addressable, intelligent Fire Alarm System as described herein and as shown on the plans.
- B. System shall be dedicated to fire service only.
- C. The fire alarm control unit shall have an operator interface to allow for loading or editing special instructions and system operating sequences as required. The system shall be capable of on site programming to accommodate and facilitate expansion, building parameter changes and changes as required by local codes. All software operations are to be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the system programs stored in memory.
- D. The fire alarm control unit shall allow for operator to set detector sensitivity ratings for each device, within code allowed parameters.
- E. To accommodate and facilitate job site changes, initiation circuits shall be individually configurable on site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring, a non-latching circuit or an alarm verification circuit.
- F. All control equipment shall have transient protection devices to comply with UL864 requirements.
- G. Fire alarm control unit shall accept addressable analog detectors and addressable monitor modules for dry contact devices.
- H. Bypass switches shall be included for system testing to prevent audible/visual signal operation, HVAC control activation, and remote fire department notification. Bypass switches for fire alarm system testing shall be located in main fire alarm control unit. Activation of bypass switches shall cause system trouble alarm.

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.



2. Include voltage drop calculations for notification appliance circuits.
3. Include 25% spare capacity on each signal circuit so that additional devices can be added.
4. Include substantiating emergency (battery) and normal power supply calculations for supervisory and alarm power requirements and calculations of notification device circuit loading (end of circuit voltage drop) to ensure proper operation of all devices.
5. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits. Drawing scale shall match engineers design drawings.
7. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
8. Include complete schematic circuit diagrams for system, including all equipment. Wiring diagram shall show point to point connections between all system components
9. Include descriptions of system operation, annunciator schedule showing titles for each zone, and manufacturer's literature marked to show model and catalog number for all equipment.
10. Include complete riser diagrams for system indicating wiring sequence of all alarm devices and control equipment shall be included with submittal data.

C. General Submittal Requirements:

1. Shop Drawings shall be prepared by persons with the following qualifications:
  - a. Trained and certified by manufacturer in fire-alarm system design.
  - b. NICET-certified fire-alarm technician, Level III minimum.

A. Wisconsin Department of Commerce – Fire Alarm System Plan Approval.

B. This project requires a submittal to the Department of Safety and Professional Services for review and approval. The following details the requirements of the contractor and the ENGINEER with regard to the fire alarm Department of Safety and Professional Services submittal.

1. Contractor's Responsibility

- a. Department of Safety and Professional Services approval is required prior to the start of fire alarm system construction. The contractor shall prepare and submit the required documents in a timely fashion to meet this requirement. If the contractor starts fire alarm system construction before approval is given by the Department of Safety and Professional Services, the contractor is responsible for all additional fees required by the Department of Commerce.
- b. Initially, prepare one set of the Department of Safety and Professional Services fire alarm submittals and send it to the Engineer for approval before proceeding with actual submittal to DSPS.
- c. After obtaining Engineer approval to proceed with the Department of Safety and Professional Services fire alarm submittal, prepare four (4) sets of the fire alarm shop drawings as approved by the Engineer that will be sent to the Department of Safety and Professional Services by the contractor. These shop drawings shall be stamped, signed and dated by a Wisconsin registered architect, professional engineer or electrical designer taking responsibility for the shop drawings. Signing and sealing shall comply with SPS 361.31(1). Note that each shop drawing copy must be stamped, signed and dated unless there is a drawing index sheet, in which case only the four index sheets need to be stamped, signed and dated. Where the

- submitter is both the designer and installer of the fire alarm system, a signature only will suffice [ch. 443.14(6), Stats.]. It shall be an original signature and date.
- d. Prepare one bound booklet of the fire alarm system device cut sheets and all calculations (indicating device power calculations, voltage drop calculations and battery calculations). These booklets do not need to be stamped, signed or dated.
  - e. Prepare a letter of transmittal listing all items being sent to the Department of Safety and Professional Services. Copy the Engineer on the letter of transmittal only.
  - f. Complete the Application for Review, Buildings, HVAC, Fire and Components – SBD-118 form.
  - g. Calculate the SDB-118 submittal fee; write a check for the appropriate amount, payable to Safety and Professional Services.
  - h. Request a review date with Department of Safety and Professional Services, Division of Safety and Buildings by emailing the completed first page of the [review application](#), SBD-118, to [planschedule@commerce.state.wi.us](mailto:planschedule@commerce.state.wi.us), or, fax it to 877-840-9172.
  - i. Assemble the submittal and send the documents described in items above to the Department of Safety and Professional Services at the appropriate address shown on at the bottom of DBS-118.
2. Plan Review Fees
    - a. Fees shall be determined in accordance with Table 302.31-1 or Table 302.31-2 found in Chapter SPS 302 of the Wisconsin Administrative Code.
    - b. Reduced plan review fees (Table 302.31-2) may be utilized for projects in municipalities that perform inspections as an agent of the Division of Safety & Buildings.
    - c. A list of “Delegated Municipalities” that perform inspections can be found at: <http://dsps.wi.gov/sb/SB-CommBldgsDeleMunis.html>
    - d. In addition to the plan review fee, a plan entry fee of \$100 shall be included with each submittal.
    - e. Per SPS 302.10, plan review fees shall be doubled for projects where the installation, erection or construction was initiated without the required Departmental approval.
  3. What to Submit
    - a. Four (4) sets of properly signed/sealed fire alarm plans. In an effort to limit handling and mailing costs, the submitter may opt to submit one (1) complete set of plans and three (3) index sheets. The plan set will be retained. A copy of the approval letter will be attached to the index sheets and returned. It shall then be the responsibility of the submitter to properly attach the approval and index page to plans matching the copy on file with the Department. A maximum of five (5) plan sets may be submitted. Additional plan sets (in excess of 5) will incur a \$25/set fee.
    - b. One (1) set of battery calculations.
    - c. One (1) set of voltage-drop calculations for each notification circuit.
    - d. One (1) copy of applicable material data sheets.
    - e. A detailed, project-specific ‘Sequence of Operation’ which clearly identifies all functions of the fire alarm system, including the transmission of alarm, supervisory and trouble signals to an approved supervising station.
    - f. A completed SBD-118 application form. The application must identify the Transaction ID No. related to the parent building review approval. Fire alarm

submittals for new construction, building additions or building alterations cannot be reviewed prior to building plan approval. The original supervising professional's signature for the building project is applicable to fire alarm submittals and a separate signature is not required. Standalone fire alarm system submittals do not require a supervising professional.

4. Plan Review Fee

- a. Forms SBD-118 (R11/11) can be downloaded from: <http://dsps.wi.gov/sb/docs/sb-Form118App.pdf> (PDF) or <http://dsps.wi.gov/sb/docs/SB-Form118App.doc> (Word)
- b. Visit Department of Safety and Professional Services, Division of Safety and Buildings Commercial Buildings Plan Review info website for additional information: <http://dsps.wi.gov/sb/SB-HomePage.html>.
- c. For scheduling of building, HVAC, and fire plans, use the electronic online request for commercial building plan appointments: <http://dsps.wi.gov/sb/SB-DivPlanReview.html>
- d. Once approved, Safety and Buildings will retain one of the sets, and will return three sets, which shall be distributed as follows:
  - 1) (1) Copy shall be retained by the fire alarm contractor on-site, and shall be used as a reference / made available to any Department of Safety and Professional Services inspectors, who may make periodic inspection visits to the site.
  - 2) (1) Copy shall be forwarded to the Owner for their records.
  - 3) (1) Copy shall be retained by the Division 26 electrical contractor, for their records. If the Division 26 electrical contractor and the fire alarm contractor are the same firm, this copy shall be kept on site, at or near to the Fire Alarm Control Panel.

C. Systems Contractor Qualifications.

1. The contractor directly responsible for this work shall be a systems contractor, who is and who has been regularly engaged in the furnishing and installation of commercial and industrial fire alarm systems of this type and size for at least the immediate past 5 years. All equipment shall be installed by a technician trained by the equipment manufacturer or a recognized training school or course for the installations of this type system. The contractor shall, if requested by the engineer; show proof of a specific individual's training. The system's contractor shall directly employ a suitable number of skilled systems installers whose normal work is systems installation and who shall install and make the wire and cable connections thereto.
2. As part of the project submittal, it shall be demonstrated to the satisfaction of the engineer that the systems contractor has adequate plant and equipment to do the work properly and expeditiously, adequate staff and technical experience.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Detailed description of equipment anchorage Field quality-control reports.

## 1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  - 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
  - 3. Record copy of site-specific software.
  - 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
    - a. Frequency of testing of installed components.
    - b. Frequency of inspection of installed components.
    - c. Requirements and recommendations related to results of maintenance.
    - d. Manufacturer's user training manuals.
  - 5. Manufacturer's required maintenance related to system warranty requirements.
  - 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
  - 7. Copy of NFPA 25.
- B. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.
- C. The Contractor shall provide three bound copies of the following, to be forwarded to the Owner at completion of project:
  - 1. As-built wiring and conduit layout diagrams showing all fire alarm devices on floor plans, including wire color code and terminal numbers, and showing all interconnections in the system.
  - 2. Electronic circuit diagrams of all FACP modules, power supplies, annunciator, data gathering panels, addressable interface modules, etc.
  - 3. Technical literature on all major parts of the system, including control panels, smoke detectors, batteries, manual stations, alarm notification appliances, power supplies, and remote alarm transmission means.

## 1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
  - 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
  - 3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
  - 4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.

5. Keys and Tools: One extra set for access to locked and tamperproofed components.
6. Audible and Visual Notification Appliances: Three of each type installed.
7. Fuses: Two of each type installed in the system.

#### 1.10 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.
- C. The addressable fire alarm system shall be connected, programmed, and tested only by the manufacturer or by an authorized distributor who stocks a full complement of spare parts for the system. Technicians performing this service shall be trained and individually certified by the manufacturer for the model of system being installed. Copies of their certifications must be included with the contractor's submittal to the engineer, prior to installation. The submittal cannot be approved without this information.
- D. System equipment shall be from a single manufacturer and shall be supported by a manufacturer authorized, established service organization that shall stock parts for the equipment supplied.
- E. Equipment shall be manufactured by a firm that has been actively manufacturing fire alarm systems for a minimum of 7 years and that offers a 3 year warranty on all control equipment.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

#### 1.11 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Receive equipment at jobsite; verify applicable components and quantity delivered per invoice.
- B. Handle equipment to prevent internal components damage, breakage, denting, and scoring enclosure and finish.
- C. Do not install damaged equipment.
- D. Store equipment in a clean, dry space and protect from dirt, fumes, water, construction debris, and physical damage.
- E. After installation, protect from damage by work of other trades.

#### 1.12 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- C. Upgrade Service:
  1. Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion.

Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

2. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

#### 1.13 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of system and associated auxiliary components that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Manufacturer's standard warranty period (minimum one year) from date of start-up.
  2. Labor and travel time for necessary repairs at the job site shall be included.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Edwards Systems Technologies (EST) , with Voice Evacuation or comparable product by one of the following. The listing of a manufacturer as "acceptable" does not imply automatic approval.
  1. NOTIFIER; a Honeywell company.
  2. Siemens Building Technologies, Inc.; Fire Safety Division.
  3. Simplex-Grinnell LP; a Tyco International company.
  4. Wheelock (Where Noted - Notification Devices Only)

#### 2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
  1. Manual stations.
  2. Heat detectors.
  3. Smoke detectors.
  4. Duct smoke detectors.
  5. Automatic sprinkler system water flow.
  6. Fire standpipe system.
- B. Fire-alarm signal shall initiate the following actions:
  1. Continuously operate alarm notification appliances.
  2. Identify alarm at fire-alarm control unit and remote annunciators.
  3. Transmit an alarm signal to the remote alarm receiving station.
  4. Unlock electric door locks in designated egress paths.
  5. Activate voice/alarm communication system.
  6. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.
  7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
  8. Record events in the system memory.
  9. Record events by the system printer.
  10. If fire alarm activation is caused by a duct smoke detector, the following actions shall be initiated:
    - a. Shut down associated air handling system.

- b. Close all smoke dampers in ducts associated with the air handling unit.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
  - 1. Valve supervisory switch.
  - 2. Sprinkler tamper switches.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
  - 1. Open circuits, shorts, and grounds in designated circuits.
  - 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  - 3. Loss of primary power at fire-alarm control unit.
  - 4. Ground or a single break in fire-alarm control unit internal circuits.
  - 5. Abnormal ac voltage at fire-alarm control unit.
  - 6. Break in standby battery circuitry.
  - 7. Failure of battery charging.
  - 8. Abnormal position of any switch at fire-alarm control unit or annunciator.
- E. System installation shall allow remote restarting of all air handling systems after having been shut down by the Fire Alarm System. Air handling systems shall automatically restart after fire alarm system has been reset.
- F. Smoke dampers in ducts shall close whenever associated air handling system is shut down either by fire alarm system activation or otherwise.

## 2.3 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit:
  - 1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
    - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
    - b. Include a real-time clock for time annotation of events on the event recorder and printer.
  - 2. Addressable initiation devices that communicate device identity and status.
    - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
    - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
  - 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
  - 1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 80 characters, minimum.
  - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
    - a. Initiating Device Circuits: Style B.
    - b. Notification Appliance Circuits: Style Y.
    - c. Signaling Line Circuits: Style 4.
    - d. Provide 25% spare capacity on circuits for additional devices.
  2. Serial Interfaces: Two RS-232 ports for printers.
- D. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- E. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet located at the fire alarm control panel.
1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
    - a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
    - b. Programmable tone and message sequence selection.
    - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
    - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
  2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
  3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
  4. Provide sufficient amplification to operate all system speakers simultaneously plus thirty (30) percent spare capacity. Calculation shall assume each speaker is connected at the one (1) watt tap.
- F. Power Supplies:
1. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
    - a. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
  2. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
    - a. Batteries: Sealed lead calcium.
  3. After 24 hours, the battery backup supply shall be capable of energizing all signal devices for a period of at least fifteen minutes. In addition, the low battery backup supply monitor shall supervise and automatically sound System Trouble in the event that a trouble occurs in the system (i.e., the batteries being disconnected or discharging to 85% of full charge). Battery and power supply capacity shall provide an additional 25% spare capacity for additional alarm signal devices that may be added to the system.
  4. Provide power supply and battery capacity for system operation. Power supply and battery capacity shall be sized to allow an additional 25% spare capacity for future



growth. The power supply shall be able to perform an automatic load test of batteries and indicate a trouble condition if the batteries fall outside a predetermined range. Power supplies shall incorporate the ability to adjust the charge rate of batteries based on ambient temperatures. Exact locations and quantities of power supplies shall be as determined by the contractor.

## 2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
  - 1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
  - 2. Station Reset: Key- or wrench-operated switch.

## 2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
  - 1. Comply with UL 268; operating at 24-V dc, nominal.
  - 2. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
  - 3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  - 4. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
  - 5. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
    - c. Provide multiple levels of detection sensitivity for each sensor.
- B. Photoelectric Smoke Detectors:
  - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
  - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    - a. Primary status.
    - b. Device type.
    - c. Present average value.
    - d. Present sensitivity selected.
    - e. Sensor range (normal, dirty, etc.).
- C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
  - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Provide remote indicator alarm for each duct detector. Mount on ceiling in corridor nearest to duct detector location.

## 2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
  1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

## 2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, equipped for mounting as indicated and with screw terminals for system connections.
  1. Device Color: Factory finished, red.
  2. Devices shall be flush mounted with surface.
  3. Strobes shall be set at 75 candela, unless otherwise noted on drawings.
  4. Exterior mounted devices shall be provided with flush mounted weatherproof backbox.
- B. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
  1. Rated Light Output:
    - a. 15/30/75/110 cd, field selectable and synchronized.
- C. Voice/Tone Notification Appliances:
  1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
  2. Speakers shall provide power taps at 1/4w, 1/2w, and 2w. Speakers shall provide UL confirmed 90 dBA sound output at 2w. Speaker tap settings shall be as follows:
    - a. Corridors – 1.0 watt
    - b. Rooms smaller than 100 sq. ft.- (10 sq. m-) – 0.5 watts
    - c. Rooms from 100 to 400 sq. ft.- (10 to 37-sq. m-) – 1.0 watt
    - d. Rooms larger than 400 sq. ft.- (37-sq. m-) – 2.0 watts
- D. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

1. The word "FIRE" is engraved in minimum ~~1-inch-~~ (25-mm-) high letters on the lens.

## 2.8 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
  1. Mounting: Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

## 2.9 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Waterflow Detector/Pressure Switches: Waterflow or pressure switches to be supplied and installed by the fire protection system contractor and wired to the Fire Alarm System by this Contractor. Provide addressable water flow/tamper module for each switch so that each switch can be individually monitored.

## 2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
  1. Verification that both telephone lines are available.
  2. Programming device.
  3. LED display.
  4. Manual test report function and manual transmission clear indication.
  5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
  1. Address of the alarm-initiating device.
  2. Address and/or Zone of the supervisory signal.
  3. Address and/or Zone of the trouble-initiating device.
  4. Loss of ac supply or loss of power.
  5. Low battery.
  6. Abnormal test signal.
  7. Communication bus failure.

- E. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. All wiring shall be installed in conduit. Flexible connectors shall be used for all devices mounted in suspended lay-in ceiling panels. All conduit, mounting boxes, junction boxes and panels shall be securely hung and fastened with appropriate fittings to insure positive grounding throughout the entire system.
- C. No wiring other than that directly associated with fire alarm or auxiliary fire protection functions shall be permitted in fire alarm conduits. There shall be NO splices in the system other than at terminal blocks. "Wire nuts" and crimp splices are NOT permitted. Permanent wire markers shall be used to identify all terminations for each circuit. For splices, use markers or other means to indicate which conductor leads to the FACP. All connections shall be made on terminal strips. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type. No more than two conductors under one connection. Wire on these terminals shall be labeled. Transposing or changing color coding of wires shall not be permitted. All conductors in conduit containing more than one wire shall be labeled on each end with "E-Z markers" or equivalent. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals shall be numbered and coded. All controls, function switches, etc., shall be clearly labeled on all equipment panels. All wiring shall be checked and tested to insure that there are no grounds, opens or shorts.
- D. All wiring shall be color coded in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run:
  - 1. Initiating Circuits Yellow(+)/Brown (-)
  - 2. Alarm Indicating Appliance Circuits Red(+)/Blue (-)
  - 3. AHU Shutdown Circuits Orange
  - 4. Door Control Circuits Gray
  - 5. Elevator Capture Circuits Violet
  - 6. Exception: Addressable initiating circuits shall comply with Paragraph below.
- E. Wire shall be 14 AWG minimum, stranded or solid copper, type THHN or THWN except for addressable loop controller circuits. Addressable loop controller circuits are to be wired with type FPL/FPLR/FPLP fire alarm cable, solid copper, AWG 18 minimum, twisted pair, installed in conduit, instead of AWG 14 THHN/THWN stranded conductors. Provide shielded cable if required by manufacturer. If shielded cable is required by manufacturer, cable shield drain wires are to be connected at each device on the loop to maintain continuity, and taped to insulate from ground. Terminate the shield at the FACP in accordance with the manufacturer's instructions. The cable shall have red jacket, with yellow (+) and brown(-) conductors.
- F. All addressable loop controller circuits shall have a minimum of 25% spare addresses for future use. "T" taps from the loop are permitted, but only if they serve no more than 30 initiating devices and/or control points, in an area which does not exceed approximately half of one story. To minimize the impact of a wiring fault on the system, isolation modules must be provided as follows:

1. After each 30 devices/control points on any addressable circuit, including taps.
  2. At each "T" tap which feeds 5 or more devices/control points.
  3. For each circuit extending outside the building.
  4. All isolation modules must be clearly labeled, readily accessible for convenient inspection, and shown on the as-builts.
- G. Initiating device or indicating appliance circuits must not be included in raceways containing AC power or AC control wiring. Within the FACP panel, any AC control wiring must be properly separated from other circuits. The enclosure must have an appropriate warning label to alert service personnel to the hazard.
- H. A unique identification number shall be assigned to each detector. (Identification shall be by zone number and device number within the zone.) This number shall be noted on the submittals and as-built plans, and also be permanently mounted adjacent to the detector or affixed to its base.
- I. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
- J. Smoke- or Heat-Detector Spacing:
1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
  2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
  3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
  4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
  5. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
  6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.
- K. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Provide weatherproof enclosures for any duct smoke detector installed outdoors.
- L. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- M. Annunciator: Install with top of panel not more than 46 inches (1150 mm) above the finished floor.
- ### 3.2 CONNECTIONS
- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
1. Smoke dampers in air ducts of designated air-conditioning duct systems.
  2. Supervisory connections at valve supervisory switches.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

### 3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  - 3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION

## SECTION 26 32 00 - STANDBY POWER GENERATOR

### PART 1 - GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Applicable provisions of Division 00 and Division 01 shall govern work in this Section.

#### 1.2 DESCRIPTION

- A. Provide a natural gas powered, standby, electrical power generator. Installation shall include generator piping, exhaust/muffler system, including insulation, and accessories.

#### 1.3 RELATED WORK

- A. Section 26 05 26 - Grounding
- B. Section 26 36 23 - Automatic Transfer Equipment
- C. Section 26 01 26 - Electrical System Testing

#### 1.4 QUALITY ASSURANCE

- A. Equipment and installation shall conform to the requirements of the following agencies:
  - 1. U.S. Environmental Protection Agency (EPA): Design Criteria of Mechanical, Electrical, and Fluid System and Component Reliability.
  - 2. National Fire Protection Association (NFPA):
    - a. NFPA-30 Flammable and Combustible Liquids Code.
    - b. NFPA-37 Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
    - c. NFPA-70 National Electrical Code (NEC), and Wisconsin amendments thereto.
    - d. NFPA-76A Essential Electrical Systems for Health Care Facilities.
    - e. NFPA-101 Life Safety Code.
  - 3. Underwriter's Laboratories (UL). Electrical Construction Material List.
    - a. Local Codes and Ordinances.
    - b. American National Standards Institute ANSI Y32.2.
    - c. Institute of Electronic and Electrical Engineers (IEEE).
    - d. National Electrical Manufacturers Association (NEMA).
- B. The following production tests shall be performed on the engine/generator assembly.
  - 1. Mechanical operation test.
  - 2. Ground tests.
  - 3. Control wiring tests.
  - 4. Operation test.
- C. Engine/generator set shall be product of a manufacturer who shall warranty engine/generator package with accessories as described herein.

#### 1.5 SUBMITTALS

- A. Shop drawing submittal shall include the following documents as a minimum:

1. Manufacturer's technical brochures and cut sheets of system equipment. Information included in the brochures and on cut sheets shall illustrate compliance with these specifications.
  2. Dimensional drawings of system equipment. As a minimum, drawings shall show critical dimensions and shall show field connection points. As a minimum, drawing shall show overall height of installation, muffler and exhaust support details, and exhaust pipe coordination with radiator exhaust duct.
  3. Fuel piping isometric with pipe sizes, pipe materials, valves, and calculations shown.
- B. Control logic diagram and connection drawing, using symbols in accordance with ANSI Y32.2, showing locations of all terminal blocks for external wiring connections
- C. Submit test reports including:
1. Certified test reports of prototype (if requested by the engineer), production, and field tests.
- D. Submit manufacturer's instructions for start-up, performing cleaning, operating, and maintaining standby power systems.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Electrical documents based on Generac Guardian Series genenerator. Equal/approved generator sets by Caterpillar, Cummins, Generac, Kohler Co., MTU Detroit Diesel are acceptable.

### 2.2 ENGINE/GENERATOR RATINGS

- A. The standby engine/generator set shall be rated at not less than 60kw, 60 kVA standby duty at 1.0 pf, 120/240V, 1ph, 3 wire, 60 Hz. Base rating on operation when equipped with operating accessories at 1,000 ft elevation and 25 degrees C. ambient temperature. Ventilating system is designed for maximum 11 degrees C. rise above room ambient.
- B. Voltage regulator shall be filtered and be capable of regulating generator output to permit starting of and running of the loads as shown on the drawings, simultaneously with a maximum of 15% voltage dip when starting any combination of loads connected to the generator with return to steady state in less than 2 sec. Steady state is defined as operation with terminal voltage remaining constant within  $\pm \frac{1}{2}$  of 1% of rated voltage.

### 2.3 ENGINE CONSTRUCTION AND RATINGS

- A. Engine speed of 1,800 rpm.
- B. Water cooled with plant-mounted radiator.
- C. Inline four stroke cycle compression ignition diesel.
- D. Naturally aspirated or turbo charged.
- E. Size at approximately 1½ hp per KW.
- F. Heavy duty industrial type.



- G. Natural Gas – gas line shall enter generator from the bottom, directly into the enclosure.
- H. 12 or 24 vdc positive engagement, solenoid shift, starting motor.

#### 2.4 ENGINE ACCESSORY EQUIPMENT

- A. Governor to maintain frequency regulation not to exceed 5% (3 Hz) from no load to rated load. Governor control system shall be compatible with and be capable of regulating engine speed to permit starting of and simultaneous running of connected loads as shown on drawings.
- B. Lubrication break-in oil.
- C. Electric fuel solenoid shut-off valve with standard fuel filter on engine.
- D. Oil drain extension through side of skid base.
- E. Heavy-duty air cleaner.
- F. Lube oil filter with replaceable elements.
- G. Overspeed cut-out.
- H. Low oil pressure cut-out.
- I. High coolant temperature cut-out.
- J. Flexible fuel connections.
- K. Seamless, flanged stainless steel, flexible exhaust connection.
- L. Engine coolant heater, wattage suitable for maintaining a 90-degree F coolant temperature, 120 V, single phase (dependant on heater wattage and available voltage at the generator) with adjustable thermostat.
- M. Battery Blanket Heater
- N. Welded steel skid type base securely mounted with anchored mounting bolts and with integral spring vibration isolators. The proper quantity and size of spring isolators shall be provided to assure that the isolators are not totally compressed during operation.

#### 2.5 ENGINE COOLING EQUIPMENT

- A. Unit Mounted Radiator.
- B. Pusher type fan.
- C. Duct flange
- D. Sized for 50% ethylene-glycol solution at 40 degrees C. ambient and 1,000 ft elevation.
- E. Ethylene-glycol antifreeze with rust inhibitor to -40 degreesC.

## 2.6 GENERATOR CONSTRUCTION

- A. 1-ph, 60 Hz.
- B. Single bearing.
- C. Synchronous type.
- D. Reconnectable.
- E. Drip-proof construction.
- F. Radio suppression.
- G. Class H Insulated.
- H. Brushless, direct-connected type exciter with shaft mounted diodes and built-in permanent magnets to eliminate field flashing.
- I. Voltage regulator to provide  $\pm 1\%$  voltage regulation from no load to rated load.
- J. Application of one-step load of 95% of rated load shall not result in voltage dip of more than 20% with recovery to within  $\pm \frac{1}{2}$  of 1% in less than 2 sec.
- K. Regulator shall be filtered to eliminate the effect of SCR loads on the regulator.

## 2.7 ENGINE/GENERATOR CONTROLLER

- A. Engine-Generator Digital Control Panel: Equivalent to Generac QT060. Top of control panel shall not be more than six (6) feet above finished floor (this may require remote mounting). Type 1 generator mounted control panel enclosure with engine and generator controls and indicators. Include the following features:
  - 1. Power source with circuit protection: 12 or 24 VDC.
  - 2. Operating temperature range:  $-40^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ .
  - 3. Humidity range: 5% to 95% non-condensing.
  - 4. Digital outputs to remote annunciator panel.
  - 5. Alarm horn.
  - 6. Indicators: not on auto, program, systems, warning.
  - 7. Alphanumeric digital display.
  - 8. Keypad with multi-function soft membrane environmentally sealed cover.
  - 9. Frequency Meter.
  - 10. True RMS AC Voltage.
  - 11. AC Output Amperage.
  - 12. Front mounted output voltage adjustment, locking screw driver type, to adjust voltage  $\pm 5\%$  from rated value.
  - 13. Push-to-test indicator lamps, one each for low oil pressure, high water temperature, overspeed, and overcrank.
  - 14. Push-to-test indicator lamps, one each for high engine temperature and low engine oil pressure pre-alarm and one run light.
  - 15. A flashing red light to indicate the generator set is not in automatic start mode.
  - 16. Engine run/off/auto selector switch.
  - 17. Engine running time meter.
  - 18. Oil pressure gauge.
  - 19. Water temperature gauge.

20. Battery voltmeter.
  21. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.
  22. Remote Alarm Contacts: Factory wired from C contacts to terminal strip for remote alarm functions required by ANSI/NFPA 110.
  23. Indicator lamps to include: overcrank, low oil pressure, high engine temperature, overspeed, not-in-auto, system ready, low battery volts, battery charger fault, low fuel, pre-alarm high engine temp, pre-alarm low oil pressure, low water temp, auxiliary alarm, auxiliary pre-alarm.
- B. 2-wire start/stop control to operate on activation of remote contact from automatic transfer switch.
  - C. Design starting system for restarting in event of false engine start by permitting engine to stop and then re-engage starter.
  - D. Overcranking protection designed to open cranking circuit after 60-sec (adjustable) if engine fails to start.
  - E. Circuitry to shut down engine when signals for high coolant temperature, low oil pressure, overcrank or overspeed are received, with reset button.
  - F. 5 to 30 minute adjustable time delay on engine shutdown after retransfer to normal to allow unloaded running cool down.
  - G. The NEMA 1 enclosed control panel shall be mounted on the generator set with vibration isolators. The control shall include surge suppression for protection of solid state components. A front control panel illumination lamp with On/Off switch shall be provided. The engine-generator set starting batteries shall power the monitor.
  - H. Emergency stop switch to be located outside of the generator room in a location selected by the Engineer.
  - I. Heavy duty alternator for battery charging while plant runs.
  - J. Line circuit breakers, molded case, resetable type, [\_\_\_] amp, 3 pole, 600V, in NEMA 1 enclosure, factory mounted on the unit. A line sensing field circuit breaker may be provided. Circuit breakers shall be UL or CSA listed for use as service equipment.
- 2.8 GENERATOR REMOTE STOP SWITCH.
- A. Guarded Emergency stop switch mounted on stainless steel plate labeled "Generator Emergency Stop".
- 2.9 STARTING BATTERIES
- A. Heavy duty, diesel starting type, flooded wet cell lead-antimony storage batteries. Provide a 12 or 24 volt system with number of batteries and battery capacity as sized by the manufacturer adequate for (4) 30 second cranking periods (total of 2 minutes) along with all additional loads being run on the DC system.
  - B. Stranded copper battery cables.
  - C. Unit mounted, by factory metal rack, plastic coated or with acid resistant paint.

## 2.10 AUTOMATIC BATTERY CHARGER

- A. Automatic battery charger shall have a transistor controlled magnetic amplifier circuit to float the batteries and shall equalize and taper to float voltage after start cycle has dropped the voltage of the batteries.
- B. Automatic ac line compensation.
- C. Current limiting circuit to limit the current to the rating of the charger.
- D. Silicone diode full-wave rectifiers.
- E. Surge suppressor on the AC input.
- F. DC ammeter and voltmeter.
- G. Fused AC input and DC output.
- H. 10 amp DC output minimum, size to carry DC continuous load current and simultaneously recharge the battery within 4-hrs.
- I. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30 VDC for remote indication of:
  - 1. Loss of AC power-red light (no relay contact).
  - 2. Low battery voltage-red light.
  - 3. High battery voltage-red light (no relay contact).
  - 4. Charger fail-red light.
- J. NEMA 1 enclosure for wall mounting.

## 2.11 EXHAUST EQUIPMENT

- A. Exhaust silencer.
  - 1. Maximum sound pressure of 72 dB and 7 meters distance when operating under normal operation conditions.
  - 2. Companion flanges and gaskets.
  - 3. Provide with drain plug at bottom of muffler opposite of exhaust outlet.
  - 4. Exhaust Piping: Black steel with condensate drip pocket and drain valve.
- B. Insulation.
  - 1. Insulate piping and silencer with Johns-Manville "Metal-On," Eagle-Pitcher "Tab-lok"
  - 2. Aluminum cover over insulation.
  - 3. Insulation rated for 650 degrees C.

## 2.12 UNIT ENCLOSURE

- A. Enclosure: Weather protective housing with the following features:
  - 1. Galvanized steel body
  - 2. Lifting points on base frame
  - 3. Stainless steel flush fitting latches and hinges
  - 4. Zinc plated or stainless steel fasteners
  - 5. Sheet steel components pre-treated with zinc phosphate prior to polyester powder coating
  - 6. Lockable wide door on each side installed to allow 180 degree opening rotation

7. Radiator fill access door with lockable cover
8. Lube oil and coolant drains piped to the exterior of the enclosure skid base
9. Lockable fuel fill cap
10. Battery can only be reached through lockable doors
11. Sound attenuation housing to limit noise level not to exceed 70dB at 7 meters

### PART 3 - EXECUTION

#### 3.1 INSPECTION

- A. Examine area to receive engine/generator for adequate clearance for engine/generator installation.
- B. Examine room air intake and exhaust to assure adequate air requirements.
- C. Verify that mounting area is level and free of irregularities.
- D. Start work only after unsatisfactory conditions are corrected.

#### 3.2 INSTALLATION

- A. Engine-generator.
  1. Install engine/generator in accordance with manufacturer's written instructions and NEC.
  2. Lubrication and break-in oil to be supplied and installed by supplier's or manufacturer's technician at time of start-up.
  3. Anti-freeze with rust inhibitor (set to -40 degrees C.) to be supplied and installed by supplier's or manufacturer's technician at time of start-up.
- B. Starting batteries and charger.
  1. Install batteries and connect cables.
  2. Wall mount battery charger near batteries and extend battery charging wires in conduit under floor.
- C. Remote emergency stop switch.
  1. Mount remote emergency stop switch outside the standby generator room near the entrance door or near the enclosure where mounted outside.
- D. Exhaust system.
  1. Install a black steel piping system in accordance with industry standards.
  2. Provide with drip pocket to collect condensation and drain valve.
  3. Size pipe as recommended by engine manufacturer.
  4. Pitch horizontal piping downward away from engine, minimum of 8 ft above floor, with outside rainguard.
  5. Insulate silencer and piping. Do not insulate flexible connection.
  6. Cover insulation with aluminum cover.
  7. Use sweep elbows on exhaust system. Minimum inside radius shall be three times the inside pipe diameter.
  8. Exhaust piping shall specifically conform to the requirements of NFPA 37 whether specifically indicated on the plans or not.
- E. Fuel supply equipment.
  1. Install piping in accordance with industry standards and EPA regulations.

- F. Sign
1. A sign shall be placed at the service entrance equipment, indicating type and location of on-site emergency power sources.
  2. Where the grounded circuit conductor connected to the emergency source is connected to a grounding electrode conductor at a location remote from the emergency source, provide a sign at the grounding location that identifies all emergency and normal sources connected at that location.

### 3.3 FIELD TESTS PRIOR TO START UP

- A. Megger check of phase-to-phase and phase-to-ground insulation levels. Do not megger check solid-state equipment.
- B. Ground continuity.
- C. Short circuit.
- D. Perform additional tests according to engine/generator manufacturer's instructions.

### 3.4 CLEANING

- A. Clean equipment and equipment room floor prior to start- up.
- B. Touch up scratches or marred surfaces to match original finish.

### C. SUPPLIER'S OR MANUFACTURER'S SERVICES

- D. Retain services of engine/generator set manufacturer's factory trained technician employed by engine/ generator set manufacturer or his authorized distributor to perform following services:
  1. Installation Services:
    - a. Visit project site to review installation requirements with Contractors involved. Visit shall be made prior to permanently installing equipment and making mechanical or electrical connections.
    - b. Electrical Contractor shall coordinate meeting with parties involved.
  2. Testing Services:
    - a. In addition to normal factory tests, perform on-site installation acceptance tests on the standby power generator. A building load test and a full load test shall be performed as outlined in NFPA 110, Chapter 5. Document all parameters as indicated in NFPA 110 and submit to the engineer for review and acceptance. Additional testing and documentation required by the authority having jurisdiction shall also be performed.
    - b. Include a minimum of six simulated power failures in the presence of transfer switch manufacturer's start-up representative.
    - c. Test remotely connected engine/generator status indication signals.
    - d. Test transfer switch.
  3. Instructional Services: Provide a comprehensive demonstration to Owner or maintenance personnel and Engineer of system maintenance and operation after load bank test and after engine/generator set is electrically connected to automatic transfer switch.

### 3.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Lift engine/generator using eyes, yokes and skids provided by manufacturer.

- B. Do not store indoor type equipment exposed to weather.
- C. Protect from work of other trades.

END OF SECTION

This Page Intentionally Left Blank



## SECTION 26 36 23 - AUTOMATIC TRANSFER EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Applicable requirements of Division 0 and Division 1 shall govern work in this section.

#### 1.2 DESCRIPTION

- A. Provide a factory assembled, metal enclosed, automatic transfer switch for distribution and control of power from normal power supply or from output of a standby engine/generator sets upon failure of normal power supply to outgoing feeder terminals and automatic retransfer back to normal power supply upon resumption of normal service. Transfer switches shall be open transition by-pass isolation type.

#### 1.3 RELATED WORK AND REQUIREMENTS

- A. Section 26 05 26 - Grounding
- B. Section 26 32 00 - Standby Power Generator
- C. Section 26 01 26 - Electrical System Testing

#### 1.4 QUALITY ASSURANCE

- A. Equipment shall comply with the requirements of the following Regulatory Agencies:
  - 1. U.S. Environmental Protection Agency (EPA). Design criteria for Mechanical, Electrical, and Fluid System and Component Reliability.
  - 2. National Fire Protection Association (NFPA)
  - 3. Underwriters' Laboratories, Inc. (UL)
  - 4. Local Codes and Ordinances
  - 5. American National Standards Institute (ANSI)
  - 6. National Electrical Manufacturers Association (NEMA). Standard ICS.
- B. Perform the following production tests on the transfer switch:
  - 1. Operation of individual components.
  - 2. Correct overall sequence of operation.
  - 3. Transfer time.
  - 4. Voltage.
  - 5. Dielectric strength test per NEMA Standard ICS 1-109.05.
- C. A prototype of the switch shall have been subjected to and have passed the following tests by a certified independent testing laboratory:
  - 1. Overload and endurance at 480 VAC per Table 21.2 and 23.2 of UL 1008 when enclosed per Table 1.6.
- D. Provide with full rated neutral bar.
- E. transient voltage test shall be conducted across the normal source terminals, the emergency source terminals, and between opposite normal and emergency source terminals. A certified laboratory test report from an independent testing laboratory shall be furnished to verify conformance.

## 1.5 SUBMITTALS

- A. Shop drawings shall indicate transfer switch, control panel and enclosure dimensions, control arrangements, and single line diagrams in accordance with ANSI Y 32.2 indicating connections and controls.
- B. Submit manufacturer's written recommendations for storage and protection, installation instructions, and field test requirements.
- C. Submit manufacturer's instructions for start-up, performing cleaning, operating, and maintaining transfer switch systems.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Electrical documents based on Generac Nexus Smart Switch RTS transfer switch. Other approved transfer switches, by other manufacturers will be acceptable.

### 2.2 TRANSFER SWITCH RATINGS

- A. Switch shall be 2 pole, 120/240V 1-phase, open transition type..
- B. Minimum Short Circuit Rating.
  - 1. 18,000 rms sym amps

### 2.3 EQUIPMENT SWITCH CONSTRUCTION

- A. The switch shall be rated for continuous duty
- B. Load carrying parts shall have 600-volt insulation and main contacts, as well as arcing contacts and shall be replaceable without disassembly of the operating mechanism or disconnection of power conductors.
- C. The transfer switch shall consist of a power transfer module and a control module separately mounted. Control module shall be mounted on the inside surface of the enclosure door to facilitate adjustment and service. Harnessing between transfer module and control module shall have built-in disconnect.
- D. The automatic transfer switch shall be, listed by Underwriter's Laboratories.
- E. Transfer switch shall be mounted in NEMA 1 enclosure.
- F. The transfer switches shall be capable of switching classes of load and shall be rated for continuous duty when installed in a non-ventilated enclosure constructed in accordance with Underwriters' Laboratories, Inc. Standard UL-508.
- G. The transfer switches shall be equipped with a manual operator per paragraph 14 of UL standard 1008 that is designed to prevent injury to the operating personnel if the electrical operator should suddenly become energized during manual transfer. The manual operator shall provide the same contact-to-contact transfer speed as the electric operator to prevent a flashover from switching the main contacts slowly. A mechanical visual indicator for the switch position shall be provided.

- H. Relay, timers, control wiring and accessories shall be front accessible. Test switch and pilot lights shall be on front of cabinet door. The voltage sensing relays and adjustable times shall be capable of being adjusted while energized, through calibrated dials. Control wire terminals shall be ring or locking spade terminals.
- I. Wiring shall be identified by tubular sleeve-type markers.

## 2.4 ACCESSORIES

- A. The control panel shall be micro-processor based, have a digital display, and contain the following accessories, which shall be capable of adjustment via the control panel:
  - 1. Engine starting contacts, gold plated for low voltage DC service. Contacts to close on failure of normal source to initiate engine starting.
  - 2. Auxiliary contact to open when normal fails.
  - 3. Independent voltage and frequency sensing network to prevent transfer to emergency until generator voltage is 90% of nominal and generator frequency is 95% of nominal.
  - 4. Time delay on engine starting .5 to 3 second adjustable time delay to ignore momentary outages, factory set at 3 seconds.
  - 5. Adjustable time delay on retransfer to normal (motor driven type - 0 to 30 minutes) fixed 5 minute unloaded running time for cool-down of stand-by plant after retransfer to normal.
  - 6. Solid State Close Differential Relay protection on normal. Three Close Differential Sensing Relays factory set for 90% pickup, 80% dropout. Relays are adjustable in the field.
  - 7. Test switch to be provide for testing operation of emergency plant and transfer switch (simulates normal power failure).
- B. Provide the following accessories as part of the transfer switch assembly:
  - 1. Auxiliary Contact on main shaft closed on normal.
  - 2. Auxiliary Contact on main shaft closed on emergency.
- C. The following indicators shall be provided integral to the controller or via an auxiliary panel:
  - 1. Green Pilot Light for indicating switch in normal position.
  - 2. Red Pilot Light for indicating switch in emergency position.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Examine area to receive transfer switch for adequate clearance for transfer switch installation.
- B. Start work only after unsatisfactory conditions are corrected.

### 3.2 INSTALLATION

- A. Install transfer switch in accordance with manufacturer's written instructions and NEC.
- B. Electrical Contractor shall provide control wiring between transfer switch starting contacts and generator. Starting contacts for multiple transfer switches served from the same generator shall be wired in parallel. Control wiring shall be in conduit.

### 3.3 FIELD QUALITY CONTROL

- A. Field Test Prior to Start-up.
- B. Megger check of phase-to-ground insulation levels.
- C. Continuity.
- D. Do not megger check solid state equipment.
- E. Perform tests according to transfer switch manufacturer's instructions.

### 3.4 ADJUSTMENTS AND CLEANING

- A. Check adjustment of mechanism for free mechanical movement.
- B. Tighten connections and mechanical fasteners.
- C. Touch up scratched or marred surfaces to match original finish.

### 3.5 TRANSFER SWITCH START-UP

- A. Retain services of transfer switch manufacturer's factory trained technician to perform following services:
  - 1. After engine/generator load bank test and after engine/generator set is electrically connected to automatic transfer switch, provide comprehensive demonstration of system maintenance and operation to OWNER or OWNER'S maintenance personnel.
  - 2. Include minimum of six simulated power failures.

### 3.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Do not store indoor type equipment exposed to weather.
- B. Protect system equipment from work of other trades.

END OF SECTION

## SECTION 31 20 00 - EARTH MOVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Excavating and backfilling for buildings.
  - 2. Drainage course for slab on grade
  - 3. Erosion control.
  - 4. A significant portion of the subgrade preparation and over excavation has been contracted to be performed prior to commencement of this contract.
- B. Refer to Grading Plan and Cross Sections for over-excavation cross sections, proposed grades, grading construction limits, erosion control measures, construction access across existing roadway, onsite topsoil stockpile area, onsite excavation spoil material stockpile area, and existing borrow soil stockpile area.

#### 1.2 DEFINITIONS

- A. Structures: Buildings, footings and foundations, or other man-made stationary features constructed above or below the ground surface.
- B. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

#### 1.3 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
- B. Reference the Site Plans for information on: where to install erosion control measures.

#### 1.4 SITE CLEARING

- A. Remove existing small trees, shrubs, lawns and/or other plant material from the construction limits shown on the plan. Strip existing topsoil for the construction limits shown on the plan.

#### 1.5 QUALITY ASSURANCE

- A. Reference the City of Madison Standard Specifications for Public Works Construction, latest edition.

1. The City's specification takes precedence over this spec section.
- B. Pre-excavation Conference: Conduct conference at Project site.

## 1.6 RELATED WORK

- A. Division 02: Geo Technical Investigation
- B. Section 31 25 00: Erosion Control

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. Refer to unit prices for required quantities.
- B. Spoil and topsoil provided by contractor per unit prices.
- C. Fill provided by contractor per unit prices
- D. Drainage course aggregate below building pad provided by contractor per unit prices.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect and maintain erosion and sediment controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
- C. Topsoil Stripping:
  1. Remove sod, grass, plants, and brush before stripping topsoil.
  2. Strip topsoil and stockpile onsite for reuse, where shown on plan.

### 3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
  - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
  - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer needed.

### 3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

### 3.5 STORAGE OF SOIL MATERIALS

- A. Stockpile excavated topsoil and spoil material where shown on plan. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.7 BACKFILL

- A. Place and compact backfill in excavations promptly to the proposed grades (allowing for drainage course layer) shown on the plan.
- B. Place backfill on subgrades free of mud.
- C. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material..

### 3.8 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  - 1. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
  - 2. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

### 3.9 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
  - 1. Scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent. Place in maximum 12" lifts, compacted to minimum 95% modified proctor density.

### 3.10 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  - 1. Provide a smooth transition between adjacent existing grades and new grades.
  - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site & Building Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances: Plus or minus 1/2 inch.

### 3.11 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
  - 1. Place drainage course 6 inches or less in compacted thickness in a single layer.
  - 2. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
  - 3. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

### 3.16 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
  - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.



3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property. Leave areas in clean and neat condition. Grade site surface to prevent freestanding surface water.

END OF SECTION 31 20 00

This Page Intentionally Left Blank

## SECTION 32 17 23 - PAVEMENT MARKINGS

### 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 remove and apply the pavement markings as provided for in these specifications and on the drawings. Included are the following topics:

#### 1.2 RELATED WORK

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

#### 1.3 SUBMITTALS

- A. Submit the specifications for each pavement marking material to project architect/engineer (A/E) unless otherwise directed by the City of Madison Construction Representative at the Pre-Construction Meeting. The submittal for each material shall include the following at a minimum:
  - 1. Color
  - 2. Batch Number
  - 3. Date Manufactured (Material more than one year old will not be accepted)
  - 4. Manufacturer Name and Address.

#### 1.4 REFERENCES

- A. Reference the City of Madison Standard Specifications for Public Works Construction, latest edition.
  - a. The City's specification takes precedence over this spec section.
- B. Wherever WisDOT or SSHSC appears in this specification it shall be construed to mean the pertinent sections of the State of Wisconsin, Department of Transportation, Standard Specifications for Highway and Structure Construction (SSHSC), current edition, and all supplemental and interim supplemental specifications, as they may pertain, except this contract shall be a lump sum contract and measurement and basis of payment methods shall not apply.

### PART 2 - MATERIALS

#### 2.1 PAVEMENT MARKINGS

- A. Pavement markings shall be yellow and meet the requirements of the WisDOT SSHSC Section 646.2.

## PART 3 - EXECUTION

### 3.1 REMOVING PAVEMENT MARKINGS

- A. Remove pavement markings from locations the plans show or as the City of Madison Construction Representative directs. Do not damage, discolor, leave a detrimental residue on the surface, or paint over existing markings. Provide a dust control system and remove accumulated sand or other materials.
- B. If blast cleaning within 10 feet of a building, traffic lane or public area, remove all dust and other residue continuously while blast cleaning. Collect, haul, and dispose of dust or residue from removals. Repair damage caused by the contractor's removal operations.

### 3.2 PAVEMENT MARKINGS

- A. Install pavement markings at the locations shown on the drawings. Remove all dust, dirt, oil, grease, loose paint, gravel, debris, or other materials and contaminants that might prevent bonding to the pavement by sweeping or air jetting immediately before apply the markings. Ensure that lines have a uniform cross section and color. Provide a sharp cutoff on both sides and ends of the line. Do not damage existing pavement markings that will remain in place. Protect freshly applied markings until the line is dry or cured enough to prevent pickup under traffic.
- B. Apply rate per the manufacturers recommended application rate based on the temperature and surface material.
- C. Pavement markings shall have the dimensions shown on the drawing. If not otherwise specified, marking lines shall have a minimum width of 4 inches. Diagonal marking lines shown on the drawings shall be 4 inches wide, 36 inches on center.

END OF SECTION 32 17 23



December 12, 2013

Robert Phillips  
City of Madison  
210 Martin Luther King Jr. Blvd  
Room 115  
Madison WI 53703

**SUBJECT:** Coverage Under WPDES General Permit No. WI-S067831-04: Construction Site Storm Water Runoff

Permittee Name: City of Madison  
Site Name: Highland Manor Storm Shelter  
FIN: 49882

Dear Permittee:

The Wisconsin Department of Natural Resources received your Water Resources Application for Project Permits or Notice of Intent, on December 02, 2013, for the Highland Manor Storm Shelter site and has evaluated the information provided regarding storm water discharges from your construction site. We have determined that your construction site activities will be regulated under ch. 283, Wis. Stats., ch. NR 216, Wis. Adm. Code, and in accordance with Wisconsin Pollutant Discharge Elimination System (WPDES) General Permit No. WI-S067831-04, Construction Site Storm Water Runoff. All erosion control and storm water management activities undertaken at the site must be done in accordance with the terms and conditions of the general permit.

The **Start Date** of permit coverage for this site is December 12, 2013. The maximum period of permit coverage for this site is limited to 3 years from the **Start Date**. Therefore, permit coverage automatically expires and terminates 3 years from the Start Date and storm water discharges are no longer authorized unless another Notice of Intent and application fee to retain coverage under this permit or a reissued version of this permit is submitted to the Department 14 working days prior to expiration.

A copy of the general permit along with extensive storm water information including technical standards, forms, guidance and other documents is accessible on the Department's storm water program Internet site. To obtain a copy of the general permit, please download it and the associated documents listed below from the following Department Internet site:

<http://dnr.wi.gov/topic/stormwater/construction/forms.html>

- Construction Site Storm Water Runoff WPDES general permit No. WI-S067831-04
- Construction site inspection report form
- Notice of Termination form

If, for any reason, you are unable to access these documents over the Internet, please contact me and I will send them to you.

To ensure compliance with the general permit, please read it carefully and be sure you understand its contents. Please take special note of the following requirements (This is not a complete list of the terms and conditions of the general permit.):



1. The Construction Site Erosion Control Plan and Storm Water Management Plan that you completed prior to submitting your permit application must be implemented and maintained throughout construction. Failure to do so may result in enforcement action by the Department.
2. The general permit requires that erosion and sediment controls be routinely inspected at least every 7 days, and within 24 hours after a rainfall event of 0.5 inches or greater. Weekly written reports of all inspections must be maintained. The reports must contain the following information:
  - a. Date, time, and exact place of inspection;
  - b. Name(s) of individual(s) performing inspection;
  - c. An assessment of the condition of erosion and sediment controls;
  - d. A description of any erosion and sediment control implementation and maintenance performed;
  - e. A description of the site's present phase of construction.
3. A **Certificate of Permit Coverage** must be posted in a conspicuous place on the construction site. The Certificate of Permit Coverage (WDNR Publication # WT-813) is enclosed for your use.
4. When construction activities have ceased and the site has undergone final stabilization, a Notice of Termination (NOT) of coverage under the general permit must be submitted to the Department.

It is important that you read and understand the terms and conditions of the general permit because they have the force of law and apply to you. Your project may lose its permit coverage if you do not comply with its terms and conditions. The Department may also withdraw your project from coverage under the general permit and require that you obtain an individual WPDES permit instead, based on the Department's own motion, upon the filing of a written petition by any person, or upon your request.

If you believe that you have a right to challenge this decision to grant permit coverage, you should know that the Wisconsin statutes and administrative rules establish time periods within which requests to review Department decisions must be filed. For judicial review of a decision pursuant to ss. 227.52 and 227.53, Wis. Stats., you have 30 days after the decision is mailed, or otherwise served by the Department, to file your petition with the appropriate circuit court and serve the petition on the Department. Such a petition for judicial review must name the Department of Natural Resources as the respondent.

To request a contested case hearing pursuant to s. 227.42, Wis. Stats., you have 30 days after the decision is mailed, or otherwise served by the Department, to serve a petition for hearing on the Secretary of the Department of Natural Resources. All requests for contested case hearings must be made in accordance with s. NR 2.05(5), Wis. Adm. Code, and served on the Secretary in accordance with s. NR 2.03, Wis. Adm. Code. The filing of a request for a contested case hearing is not a prerequisite for judicial review and does not extend the 30-day period for filing a petition for judicial review.

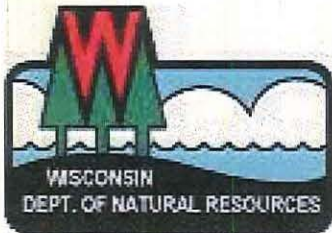
Thank you for your cooperation with the Construction Site Storm Water Discharge Permit Program. If you have any questions concerning the contents of this letter or the general permit, please contact Dan Bekta, P.E. at (608) 275-3201.

Sincerely,



E. Dan Bekta, P.E.  
South Central Region  
Water Resources Engineer

ENCLOSURE: Certificate of Permit Coverage



# CERTIFICATE OF PERMIT COVERAGE

UNDER THE  
WPDES CONSTRUCTION SITE STORM WATER RUNOFF PERMIT  
Permit No. WI-S067831-04

Under s. NR 216.455(2), Wis. Adm. Code, landowners of construction sites with storm water discharges regulated by the Wisconsin Department of Natural Resources (WDNR) Storm Water Permit Program are required to post this certificate in a conspicuous place at the construction site. This certifies that the site has been granted WDNR storm water permit coverage. The landowner must implement and maintain erosion control practices to limit sediment-contaminated runoff to waters of the state in accordance with the permit.

## EROSION CONTROL COMPLAINTS

should be reported to the WDNR Tip Line at  
**1-800-TIP-WDNR (1-800-847-9367)**

Please provide the following information to the Tip Line:

WDNR Site No. (FIN): 49882

Site Name: Highland Manor Storm Shelter

Address/Location: Manor Dr and Moorland Rd City of MADISON

Additional Information:

Landowner: City of Madison

Landowner's Contact Person: Robert Phillips

Contact Telephone Number: (608) 266-4751

Permit Start Date: December 12, 2013

By: E. D. Bekt



City of Madison Engineering Division  
**STORMWATER MANAGEMENT PERMIT**

Permit Number: ENGT20-2014-00560

City Engineering: (608) 266-4751

Location of Work: 10 Manor DR

Parcel: 071031200927

Permittee: Kevin Briski

Telephone: (608) 266-4711

Email: kbriski@cityofmadison.com

Owner: CITY OF MADISON PARKS

Telephone:

| FEE SCHEDULE            |        | APPROVALS    |     |
|-------------------------|--------|--------------|-----|
| New Impervious Area Fee | 241.52 | Plan Review: | TNT |
| Base Fee                | 400.00 | Issuance:    | TNT |
| Total Fee Amount        | 641.52 |              |     |
| <hr/>                   |        |              |     |
| Total Invoiced Amount   | 641.52 |              |     |
| Paid                    | 641.52 |              |     |
| Balance Due             | 0.00   |              |     |

**CALL 811 or (800) 242-8511**  
**(262) 432-7910**  
**(877) 500-9592 (emergency only)**

**PROPOSED WORK Highland Manor Community Safe Room**

**Construction Start Date:** 04/15/2014      **Estimated Completion Date:** 12/01/2014

**Existing Impervious Area (before project):** 0 Sq. Ft.

**New Impervious Area (Outside footprint of existing impervious Area):** 024152 Sq. Ft.

**Redeveloped Impervious Area (inside original impervious footprint):** 0 Sq. Ft.

**Removed Impervious Area (from inside original impervious footprint):** 0 Sq. Ft.

**Net Impervious Area (total after project):** 24152 Sq. Ft.

**Total Site Area:** 120805 Sq. Ft.

**Storm Water Management Requirements**

☐ 40% TSS Reduction      ☒ 80% TSS Reduction (New Development)      ☐ 80% TSS Reduction (TMDL Redevelopment)

☒ Oil & Grease Removal      ☐ Infiltration      ☐ Groundwater Recharge      ☐ Thermal Control

☒ Runoff Control - Detention

**Maintenance Agreement Executed:**

FOR CITY OF MADISON USE ONLY: **APPROVED**

Tim Troester

02/13/2014

- Stormwater Management Permit Reviewer

Date

See page two of this permit for Permit Conditions and Requirements.





City of Madison Engineering Division  
**STORMWATER MANAGEMENT PERMIT**

Permit Number: ENGT20-2014-00560

City Engineering: (608) 266-4751

---

**Location of Work:** 10 Manor DR

**Parcel:** 071031200927

**Permittee:** Kevin Briski

**Telephone:** (608) 266-4711

**Email:** kbriski@cityofmadison.com

**Owner:** CITY OF MADISON PARKS

**Telephone:**

---

**Permit Conditions and Requirements:**

Failure to abide by any of the following permit conditions will be considered a violation of the City's Storm Water Management Ordinance (MGO Ch. 37) and can result in the issuance of Official Notices, citations, and/or referral to the City Attorney for resolution of non-compliance.

A Professional Engineer currently licensed in the State of Wisconsin shall certify the initial installation and implementation of the Best Management Practices (BMPs) shown on the approved stormwater management plan. Documentation shall be submitted to the administrative authority using the standard forms available from City Engineering and found on the City's website at <http://www.cityofmadison.com/engineering/Permits.cfm>.

Any property owner required to have a Storm Water BMP or maintenance agreement on the property as part of a stormwater management plan shall submit to the administrative authority an annual report reviewing the condition of the practice(s) and the maintenance performed during the past calendar year. This report shall be submitted and sealed by a Professional Engineer currently licensed in the State of Wisconsin per MGO Chapter 37.



City of Madison Engineering Division  
**EROSION CONTROL PERMIT**

Permit Number: ENG100-2014-00558

City Engineering: (608) 266-4751

Location of Work: 10 Manor DR

Parcel: 071031200927

Permittee: Thomas Maglio

Telephone: (608) 266-6518

Email: tmaglio@cityofmadison.com

Owner: CITY OF MADISON PARKS

Telephone:

| FEE SCHEDULE                 |        | APPROVALS    |     |
|------------------------------|--------|--------------|-----|
| Full Plan Base Fee           | 200.00 | Plan Review: | TNT |
| Total Disturbed Area Fee     | 594.10 | Issuance:    | TNT |
| Total Fee Amount 794.10      |        |              |     |
| Total Invoiced Amount 794.10 |        |              |     |
| Paid 794.10                  |        |              |     |
| Balance Due 0.00             |        |              |     |

CALL 811 or (800) 242-8511  
(262) 432-7910  
(877) 500-9592 (emergency only)

**PROPOSED WORK: Highland Manor Community Safe Room**

**Project Description:** new shelter for Highland Manor

**Permit Type:** Full Plan

**Construction Start Date:** 09/18/2011      **Permit Expiration Date:** 05/15/2015      **Seed Sod Restore Date:** 11/21/2014

**USLE Rate:** 17      **Total Disturbed Area:** 118820

☐ EC Checklist Attached      ☒ EC Plan Attached      ☐ Pumping Plan Attached

FOR CITY OF MADISON USE ONLY: **APPROVED**

Tim Troester

02/13/2014

- Erosion Control Permit Reviewer

Date

Full Plan

See page two of this permit for Permit Conditions and Requirements.



City of Madison Engineering Division  
**EROSION CONTROL PERMIT**

Permit Number: ENG100-2014-00558

City Engineering: (608) 266-4751

---

**Location of Work:** 10 Manor DR

**Parcel:** 071031200927

**Permittee:** Thomas Maglio

**Telephone:** (608) 266-6518

**Email:** tmaglio@cityofmadison.com

**Owner:** CITY OF MADISON PARKS

**Telephone:**

---

**Permit Conditions and Requirements:**

Failure to abide by any of the following permit conditions will be considered a violation of the City's Erosion Control Ordinance (MGO Ch. 37) and can result in the issuance of Official Notices, citations, and/or referral to the City Attorney for resolution of non-compliance.

Erosion & Sediment Control Measures are to be installed prior to any land disturbance activities.

Within ten (10) days of the completion of the project or site stabilization the applicant shall submit an Erosion Control Notice of Termination (ECNOT). The ECNOT should be sent to the administrative authority that initially approved your permit.

The Erosion Control Permit applicant shall conduct a pre-construction meeting attended by a Professional Engineer responsible for initial implementation certification of the erosion control plan. The Professional Engineer shall document and submit minutes of this meeting to City Engineering.

A Professional Engineer currently licensed in the State of Wisconsin shall certify the initial installation and implementation of the measures shown on the approved erosion control plan. Documentation on the City's Installation Certification form shall be submitted to the administrative authority within one (1) week of the installation. The certification form can be found on the City's webpage at <http://www.cityofmadison.com/engineering/Permits.cfm>.

As part of the Erosion Control Permit requirements this construction project requires erosion control inspections and reporting by the permittee (or by their authorized inspector). Inspections shall be conducted a minimum of once per week and also after every 24-hour rain event of 0.5" or more precipitation. The results of these inspections shall be entered on the City's permit and inspection tracking system.

This project falls in the area subject to increased erosion control enforcement as authorized by the fact that it is in the ROCK RIVER TMDL ZONE and by Resolution 14-00043 passed by the City of Madison Common Council on 1/21/2014. You will be expected to meet a higher standard of erosion control than the minimum standards set by the WDNR.



Construction • Geotechnical  
Consulting Engineering/Testing

September 3, 2013  
C13064-8

Mr. Randy Wiesner  
City Engineering, Management Section  
210 Martin Luther King Jr. Blvd, Room 115  
Madison, WI 53703

Re: Geotechnical Exploration Report  
Proposed Highland Manor Storm Shelter  
Manor Drive  
Madison, Wisconsin

Dear Mr. Wiesner:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the geotechnical exploration program for the proposed storm shelter. The purpose of this exploration program was to evaluate the subsurface conditions within the proposed building and pavement areas and potential stormwater management areas and to provide geotechnical recommendations regarding site preparation, foundation, floor slab and pavement design/construction, as well as stormwater infiltration potential. We are sending you an electronic paper copy of this report and can provide a paper copy upon request.

### **PROJECT DESCRIPTION**

We understand that an approximately 100-ft by 60-ft single-story, slab-on-grade (no basement) storm shelter is proposed for this site. Finish floor elevation will be established near EL 869 ft, which will require raising existing site grades by about 4.5 to 5.5 ft. We assume that the building will be a concrete structure with maximum column loads around 105 to 115 kips and wall loads around 5 kips per lineal foot. The column pads will bear about 1.5 ft below finish floor grade, and perimeter wall footings will bear at frost depth 4 ft below finish floor grade. A parking lot is planned northeast of the building, and a future parking lot may be constructed southwest of the building. Stormwater management features may also be included in the project.

### **SITE CONDITIONS**

The site is situated southwest of Manor Drive in the middle of the Highland Manor mobile home park. The project area was originally planned to be a roadway alignment that was never constructed and is now mowed lawn. Within the project area, the site slopes down gently from northeast to southwest with about 5.5 ft of relief noted between the borings. However, just beyond the project area, the site slopes up to the north and south to rows of mobile homes. A sanitary sewer easement exists in the southwest portion of the project between Borings A-5 and A-6.

Mr. Randy Wiesner  
City of Madison Engineering  
September 3, 2013  
Page 2

## SUBSURFACE CONDITIONS

Subsurface conditions on site were explored by drilling a total of 13 Standard Penetration Test (SPT) soil borings to planned depths of 10 to 30 ft below existing site grades. Borings A-1 through A-8 were drilled to 10 ft with pavement and stormwater areas, and Borings B-1 through B-5 were drilled to 30 ft within the proposed building footprint. The borings were located in the field by City of Madison personnel who also surveyed the ground surface elevations at the boring locations, which are referenced to NAVD88(1991) vertical datum. The borings were drilled on July 19, 2013 by Badger State Drilling (under subcontract to CGC) using truck-mounted D-120 rotary drill rigs equipped with hollow-stem augers and automatic SPT hammers. Specific details on the drilling and sampling procedures are included in Appendix A.

The subsurface profile at the boring locations varies to some degree based on previous fill placement, but a generalized profile includes the following strata, in descending order:

- 2 to 8 in. of *topsoil fill*; over
- 2 to 3.5 ft of *fill* consisting of loose to medium dense sand with significant silt and gravel content or stiff lean clay with variable sand and gravel content; the fill was absent in Borings A-4, A-8 and B-1; followed by
- 4 to 19 ft of medium stiff to very stiff *lean clay* and loose to medium dense *silt, clayey silt* or *clayey sand*; note that most of the shallow "A" borings terminated in this layer; followed by
- Medium dense to very dense *sand* with variable silt and gravel content, as well as scattered cobbles/boulders to split-spoon refusal at 28.5 ft to 29.5 ft in Borings B-1 and B-2 or to the maximum depth explored in the other borings.

Groundwater was encountered in all of the borings except Boring A-3 at depths ranging from 6 ft to 13.5 ft below existing site grades (approx. EL 851 ft to 860 ft) during or shortly after drilling. Groundwater levels can be expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration, the pumping rate of nearby wells and other factors. As a reference, the typical water level in Lake Mendota is near EL 849 ft and Lake Monona is near EL 845 ft, and the water level inland is often a few feet higher than lake level. A more detailed description of the site soil and groundwater conditions is presented on the Soil Boring Logs attached in Appendix B.

## DISCUSSION AND RECOMMENDATIONS

Subject to the limitations discussed below and based on the subsurface exploration, it is our opinion that the site is suitable for the proposed construction and the building can be supported on conventional spread footing foundations. However, a time delay between fill placement and beginning foundation construction

Mr. Randy Wiesner  
City of Madison Engineering  
September 3, 2013  
Page 3

will be required within the building footprint. Additionally, some undercutting below footings may be required to remove variable lower strength native and fill soils. Our recommendations for site preparation, foundation, floor slab, pavement and stormwater infiltration design/construction are presented in the following subsections. Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix C.

## **1. Site Preparation**

We recommend that the topsoil/vegetation be stripped/removed at least 5 ft beyond the proposed construction areas, including areas required for cuts and fills beyond the proposed building footprint or pavement limits. The topsoil can be stockpiled on-site and re-used as fill in landscaped areas or hauled off site. Trees and tree roots should be removed in conjunction with topsoil stripping.

Beneath the topsoil, the soils within pavement areas are expected to consist of granular and cohesive fill soils, as well as natural cohesive soils. We recommend that the soils be checked for soft/loose areas by proof-rolling with a loaded tri-axle dump truck prior to new fill being placed. *Note that within the building footprint, it is important that the existing soils be carefully checked for footing support capability since the footings for the building will bear on newly-placed compacted granular fill above the existing soils.* If soft/loose areas are detected, these areas should be undercut and replaced with granular backfill compacted to a minimum of 95% compaction based on modified Proctor methods (ASTM D 1557) or compacted 3-in. dense graded base.

After proof-rolling and undercutting/replacement are completed (if needed) to create a stable surface, fill placement to establish site grades can occur. We recommend using granular soils within and around building areas, as well as in the upper 3 ft of pavement areas, as sand/gravel are easier to place and compact in a wider range of weather and soil moisture conditions. Silt/clay soils generally require moisture conditioning to achieve adequate compaction levels, which could delay the construction schedule. Therefore, silt/clay soils are best used in landscaped areas or in lower portions in pavement areas provided the cohesive soils can be adequately dried to achieve the required compaction. Periodic field density tests should be taken by CGC staff within the fill/backfill to document the adequacy of compactive effort.

The medium stiff clays and loose silts are considered to be slightly compressible such that the weight of the new fill and load from the building will cause the cohesive soils to consolidate and settle under the new load. We estimate that the total amount of settlement could be on the order of 1.5 in., which exceeds typically tolerable structural criteria (i.e., total settlement of 1 in. and differential settlement of 0.5 in.). We estimate that about 60% of the total settlement (about 0.8 in.) will result from the weight of the new fill, with remaining 40% of the settlement (about 0.6 in.) caused by the building load. To reduce the chance of post construction settlements exceeding typically tolerable limits, *we recommend placing the fill within and 10 ft beyond the building limits to the floor slab subgrade elevation about 4 to 6 weeks prior to beginning foundation excavation so that most of the settlement due to the weight of the new fill occurs prior to beginning foundation construction.* About three to five settlement platforms (see Appendix E for detail) should be installed within the building footprint to document that settlement has ceased prior to beginning



Mr. Randy Wiesner  
City of Madison Engineering  
September 3, 2013  
Page 4

foundation excavation. The settlement platforms should be surveyed immediately after fill placement to floor slab subgrade occurs and on a weekly basis until three consecutive readings at each settlement platform show that settlement has ceased. In other words, fill placement to the floor slab subgrade elevation should occur first, followed by a 4 to 6 week period where the underlying soils can consolidate prior to the footings being excavated through the new fill. Note that if fill placement occurs more than two months prior to beginning foundation construction, settlement monitoring will not be required.

## **2. Foundation Design**

In our opinion, the proposed building can be supported on reinforced concrete spread footing foundations bearing on newly-placed compacted granular fill above the native clay and medium dense granular fill soils. As discussed above, since the building foundations will bear on newly-placed compacted granular fill above the existing soils, it is important that the existing soils be carefully checked prior to fill placement. The allowable soil bearing pressure will be limited by the stiff to medium stiff clays building borings. The following parameters should be used for foundation design:

- Maximum net allowable bearing pressure: 3,000 psf
- Minimum foundation widths:
  - Continuous wall footings: 18 in.
  - Column pad footings: 30 in.
- Minimum footing depths:
  - Exterior/perimeter footings: 4 ft
  - Interior footings: no minimum requirement

Undercutting below footings will be required where loose sands or silts or native cohesive soils with pocket penetrometer readings (an estimate of the unconfined compressive strength of cohesive soils) of less than 1.5 tsf are encountered at or slightly below footing grade. Some undercutting below footing grade may be required, and we recommend that an allowance for this operation should be included in the project budget. Where undercutting is required, the base of the undercut excavation should be widened beyond the footing edges at least 0.5 ft in each direction for each foot of undercut depth for stress distribution purposes. Where undercut grade will be above the water table, granular backfill compacted to at least 95% compaction (modified Proctor - ASTM D1557) or well-compacted 3-in. dense graded base can be used to re-establish footing grade.

CGC should be present during footing excavations to check whether subgrades are satisfactory for the design bearing pressure and to advise on corrective measures, where necessary. We recommend using a smooth-edged backhoe bucket for footing excavations. Additionally, granular soils exposed at footing grade should be thoroughly recompacted with a large vibratory plate compactor prior to formwork/concrete placement to densify soils loosened during the excavation process. Soils potentially susceptible to

Mr. Randy Wiesner  
City of Madison Engineering  
September 3, 2013  
Page 5

disturbance from compaction (e.g., silty or clayey soils) should be hand trimmed. Provided the foundation design/construction recommendations discussed above are followed, we estimate that total and differential settlements should be on the order of 1.0 and 0.5 in., respectively.

### **3. Floor Slab**

We anticipate that the floor slab for the proposed building will be supported on newly-placed compacted granular fill and a subgrade modulus of 100 pci may be used in floor slab design. Prior to slab construction, the subgrades should be thoroughly proof-rolled/recompacted to densify soils that may become disturbed or loosened during construction activities. Areas that remain loose after recompaction should be undercut and replaced with compacted 3-in. dense graded base or granular fill. The design subgrade modulus is based on a recompacted subgrade such that non-yielding conditions are developed. To serve as a capillary break, the final 4 to 6 in. of soil placed below the slab should consist of well-graded sand or gravel with no more than 5 percent by weight passing a No. 200 U.S. standard sieve. Note that some structural engineers require a 4 to 6 in. layer of  $\frac{3}{4}$  in. or 1- $\frac{1}{4}$  in. dense graded base below the slab to increase the subgrade modulus immediately below the slab. If 6 in. of 1.25-in. dense graded base is included below the slab, the subgrade modulus can be increased to 150 pci. Fill and base layer material below the floor slab should be placed as described in the Site Preparation section of this report. To further minimize the potential for moisture migration, a plastic vapor barrier can also be utilized below the slab. The slab should be structurally separate from the foundations and have construction joints and reinforcement for crack control.

### **4. Seismic Design Category**

In our opinion, the average soil/rock properties in the upper 100 ft of the site (based on SPT blow counts (N-values) of more than 15 blows/ft, on average, in the granular soils underlying the site and undrained shear strengths exceeding 1 ksf in cohesive soils) may be characterized as a stiff soil profile. This characterization would place the site in Site Class D for seismic design according to the International Building Code (see Table 1613.5.2).

### **5. Pavement Design**

We anticipate that the subgrade soils within the parking and drive areas northeast and southwest of the building will likely consist of the existing sand and clay fill, native cohesive soils or newly-placed compacted granular fill. Pavement subgrades should be proof-rolled/recompacted, as discussed in the Site Preparation section of this report, to check for soft/loose areas. If soft/loose areas are detected these areas should be undercut/stabilized with 3-in. dense graded base or replaced with compacted granular fill. We assume that the parking lot pavement will be subjected to mainly automobile traffic with minimal truck traffic (i.e., Traffic Class I, which includes less than one design daily equivalent 18-kip single axle load – ESAL and parking lots with fewer than 50 stalls). Accordingly, the pavement section tabulated below was selected assuming a CBR of approximately 1 to 2 and a design life of 20 years.



Mr. Randy Wiesner  
City of Madison Engineering  
September 3, 2013  
Page 6

**TABLE 1**  
**RECOMMENDED LIGHT DUTY PAVEMENT SECTION**  
**(Less than 1 Daily ESAL)**

| Material               | Thickness (in.) | WDOT Specification <sup>1</sup>        |
|------------------------|-----------------|--|
| Bituminous upper layer | 1.5             | Section 460, Table 460-1, 12.5 mm      |
| Bituminous lower layer | 1.5             | Section 460, Table 460-1, 19.0 mm      |
| Dense graded base      | 8.0             | Sections 301 and 305, 31.5mm and 75 mm |
| <b>TOTAL THICKNESS</b> | <b>11.0</b>     |  |

Notes:

1. Wisconsin DOT *Standard Specifications for Highway and Structure Construction*, including supplemental specifications, but excluding Section 460.3.2 relating layer thickness to aggregate size.
2. Compaction requirements:
  - Bituminous concrete: Refer to Section 460-3.
  - Base course: Refer to Section 301.3.4.2, Standard Compaction
3. Mixture Type E-0.3 bituminous pavement is recommended; refer to Section 460, Table 460-2 of the *Standard Specifications*.

Note that if traffic volumes are greater than those assumed, CGC should be allowed to review the recommended pavement section and adjust it accordingly. The pavement design assumes a stable/non-yielding subgrade and a regular program of preventative maintenance. Alternative pavement designs may prove applicable and should be reviewed by CGC. If there is a delay between subgrade preparation and placing the base course, the subgrade should be recompacted.

**6. Stormwater Infiltration Potential**

We understand that stormwater management areas may be located in southwest portions of the site (near Borings A-5 through A-8). The soil conditions in these borings, and more generally at this site, involve fairly low permeability clays and silts to depths that extend near or below the water table. There is a shallow, relatively thin sand fill zone in three of the borings. Therefore, it is our opinion that this site generally does not appear suitable for infiltrating significant quantities of stormwater. According to

Mr. Randy Wiesner  
City of Madison Engineering  
September 3, 2013  
Page 7

NR151.12, this site may be classified as “excluded” based on less than 3 ft of separation between the bottom of the infiltration basin and the high water level (or redox/mottling in the clay). Based on the deep low permeability soils, this site may also qualify as “exempted” based on estimated infiltration rates of less than 0.6 in./hr. The following parameters should be considered for design of infiltration features:

**Infiltration Potential:** The following infiltration parameters were estimated using Table 2 of the WDNR Conservation Practice Standard 1002, *Site Evaluation for Storm Water Infiltration*. The estimated infiltration rates are as follows:

|                   |             |
|-------------------|-------------|
| • Silty clay loam | 0.04 in./hr |
| • Sandy clay loam | 0.11 in./hr |
| • Silt loam       | 0.13 in./hr |
| • Sandy loam      | 0.5 in./hr  |

Note that the infiltration rates should be considered very approximate. The Wisconsin Department of Safety and Professional Services Soil Evaluation form for Borings A-5 through A-8 is included in Appendix F.

**Groundwater:** Groundwater was noted in Borings A-5 through A-8 at 6 to 9 ft below existing grades. Redoximorphic features in some of the shallow clays also suggest occasional perched water. Groundwater levels should be expected to vary, as previously discussed.

**Bedrock:** Bedrock was not encountered in the borings to maximum depth explored.

During construction of the proposed building and parking lot and related site grading, appropriate erosion control should be provided to prevent eroded soil from contaminating the bioswale areas. Where appropriate, the stormwater design should include pretreatment to remove fine-grained soils (silt/clay) from stormwater prior to entering the infiltration area. Additionally, a regular maintenance plan should be developed to remove silt/clay soils that may accumulate in the bottom of infiltration features over time. Failure to adequately control fine-grained soils from entering the infiltration area or failure to regularly remove fine-grained soils that accumulate at the base of the infiltration feature will likely cause the stormwater management area to fail. Refer to WDNR Conservation Practice Standard 1002 and NR 151 for additional information.

## CONSTRUCTION CONSIDERATIONS

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



Mr. Randy Wiesner  
City of Madison Engineering  
September 3, 2013  
Page 8

- Due to the potentially sensitive nature of the on-site soils, we recommend that final site grading activities be completed during dry weather, if possible. Construction traffic should be avoided on prepared subgrades to minimize potential disturbance.
- Earthwork construction during the early spring or late fall could be complicated as a result of wet weather and freezing temperatures. During cold weather, exposed subgrades should be protected from freezing before and after footing construction. Fill should never be placed while frozen or on frozen ground.
- Excavations extending greater than 4 ft in depth below the existing ground surface should be sloped or braced in accordance with current OSHA standards.
- Based on proposed building grades and observations made during the field exploration, we generally do not expect groundwater to be encountered in footing excavations. However, water accumulating at the base of excavations as a result of precipitation or seepage should be controlled and quickly removed using pumps operating from filtered sump pits.

#### **RECOMMENDED CONSTRUCTION MONITORING**

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

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


\* \* \* \* \*


Mr. Randy Wiesner  
City of Madison Engineering  
September 3, 2013  
Page 9

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

Sincerely,

CGC, Inc.

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

  
William W. Wuellner, P.E.  
Senior Geotechnical Engineer

Encl: Appendix A - Field Exploration  
Appendix B - Soil Boring Location Map  
Logs of Test Borings (13)  
Log of Test Boring-General Notes  
Unified Soil Classification System  
Appendix C - Document Qualifications  
Appendix D - Recommended Compacted Fill Specifications  
Appendix E - Settlement Platform  
Appendix F - WI Dept. Safety and Professional Services Soil Evaluation Forms (4 Borings)

## **APPENDIX A**

### **FIELD EXPLORATION**

## APPENDIX A

### FIELD EXPLORATION

A total of 13 Standard Penetration Test (SPT) soil borings were drilled to planned depths of 10 to 30 ft below existing site grades. Borings A-1 through A-8 were drilled to 10 ft with pavement and stormwater areas, and Borings B-1 through B-5 were drilled to 30 ft within the proposed building footprint. The borings were located in the field by City of Madison personnel who also surveyed the ground surface elevations at the boring locations, which are referenced to NAVD88(1991) vertical datum. The borings were drilled on July 19, 2013 by Badger State Drilling (under subcontract to CGC) using truck-mounted D-120 rotary drill rigs equipped with hollow-stem augers and automatic SPT hammers. Specific details on the drilling and sampling procedures are included in Appendix A.

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

1. Boring Procedures between Samples

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

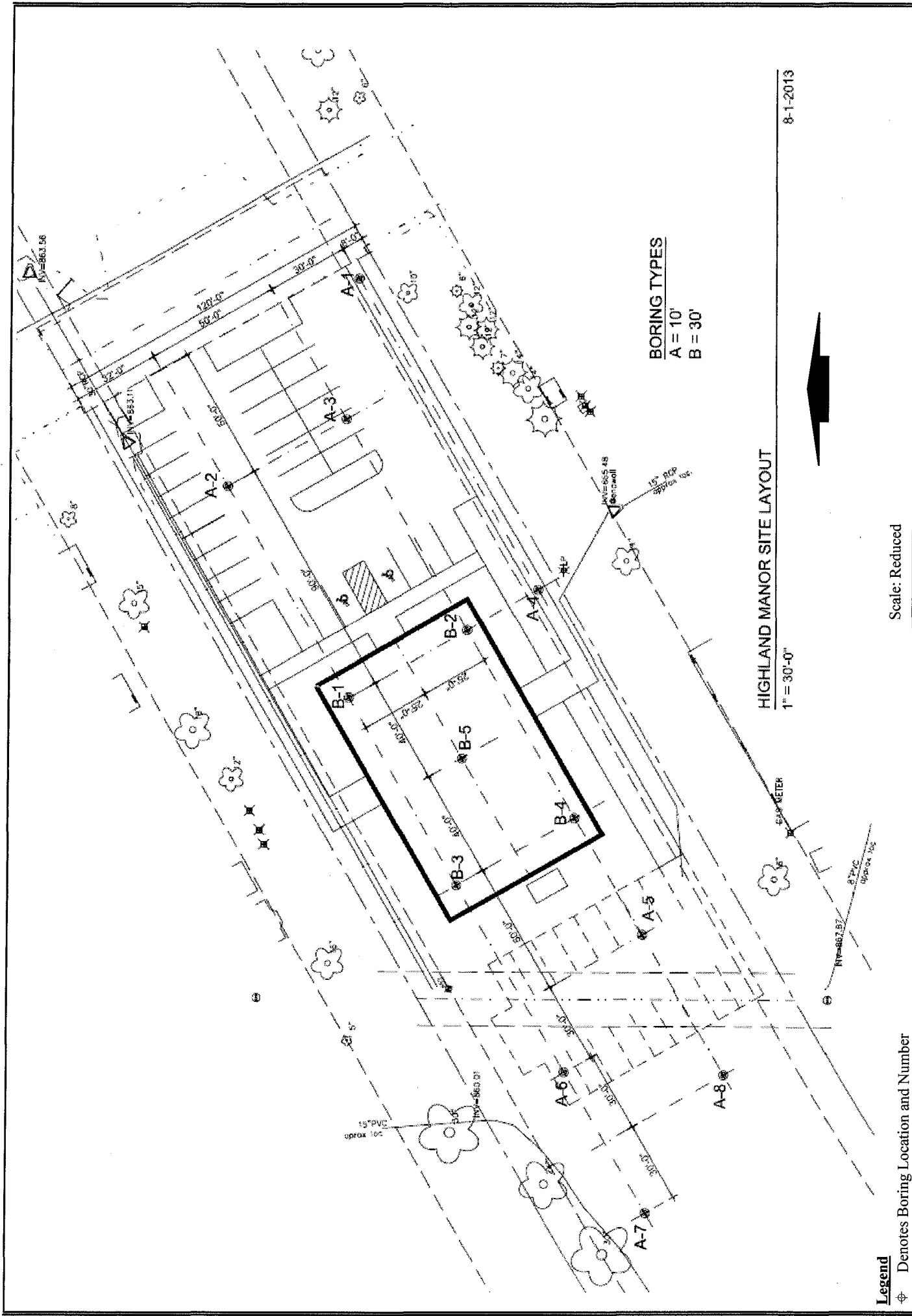
2. Standard Penetration Test and Split-Barrel Sampling of Soils  
(ASTM Designation: D 1586)

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

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

## **APPENDIX B**

**SOIL BORING LOCATION MAP  
LOGS OF TEST BORINGS (13)  
LOG OF TEST BORING - GENERAL NOTES  
UNIFIED SOIL CLASSIFICATION SYSTEM**



**BORING TYPES**  
 A = 10'  
 B = 30'

**HIGHLAND MANOR SITE LAYOUT**  
 1" = 30'-0"

8-1-2013

Scale: Reduced

**Legend**  
 Ⓢ Denotes Boring Location and Number

**Notes**

1. Borings drilled by Badger State Drilling on August 19, 2013.
2. Base map prepared by City of Madison.
3. Boring locations are approximate.

|  |                         |
|--|-------------------------|
| <b>SOIL BORING LOCATION MAP</b><br>Proposed Highland Manor Storm Shelter<br>Manor Drive<br>Madison, WI |                         |
| <b>Job No.</b><br>C13064-8   | <b>Date:</b><br>08/2013 |
| <b>CGC, Inc.</b>   |                         |





## LOG OF TEST BORING

Project **Proposed Highland Manor Storm Shelter**  
Manor Drive  
Location **Madison, Wisconsin**

Boring No. **B-1**  
Surface Elevation (ft) **863.6**  
Job No. **C13064-8**  
Sheet **1** of **1**

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

| SAMPLE |              |       |       |               | VISUAL CLASSIFICATION<br>and Remarks   | SOIL PROPERTIES     |      |    |    |    |
|--------|--------------|-------|-------|---------------|--|---------------------|------|----|----|----|
| No.    | Rec<br>(in.) | Moist | N     | Depth<br>(ft) |  | qu<br>(qa)<br>(tsf) | W    | LL | PL | LI |
| 1      | 12           | M     | 14    |               | 5.5 in. TOPSOIL FILL (OL)<br>Medium Stiff to Very Stiff, Gray/Brown (Mottled)<br>Lean CLAY, Trace Sand (CL)                                      | (2.25)              |      |    |    |    |
| 2      | 14           | M     | 8     |               |  | (1.0-1.5)           | 28.7 |    |    |    |
| 3      | 10           | M     | 7     |               |  | (0.75-1.25)         | 24.7 |    |    |    |
| 4      | 14           | M/W   | 12    |               | Grades to Medium Stiff to Stiff Silty Clay to Clayey<br>Silt (CL-ML/ML) with Depth   | (0.75-1.0)          | 21.3 |    |    |    |
| 5      | 16           | W     | 41    |               | Dense, Brown Fine to Medium SAND, Some<br>Gravel, Trace to Little Silt (SP/SP-SM)  |                     |      |    |    |    |
| 6      | 12           | W     | 36    |               | Dense, Gray-Brown Silty Fine SAND, Trace Gravel<br>and Clay, Scattered Cobbles/Boulders (SM)   |                     |      |    |    |    |
| 7      | 10           | W     | 35    |               | Dense to Very Dense, Gray-Brown Fine SAND,<br>Trace to Little Silt (SP/SP-SM)  |                     |      |    |    |    |
| 8      | 0            | W     | 50/2" |               | Pushed stone (no recovery) at 28.5 ft<br>End of Boring/Split-Spoon Refusal at 28.5 ft<br><br>Borehole backfilled with bentonite slurry and chips |                     |      |    |    |    |

### WATER LEVEL OBSERVATIONS

While Drilling  $\nabla$  **9.0'** Upon Completion of Drilling \_\_\_\_\_  
Time After Drilling \_\_\_\_\_  
Depth to Water \_\_\_\_\_  
Depth to Cave in \_\_\_\_\_

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

### GENERAL NOTES

Start **8/19/13** End **8/19/13**  
Driller **BSD** Chief **AP** Rig **D-120**  
Logger **JF** Editor **DAS**  
Drill Method **2.25" HSA 0-10; 3-7/8"**  
**RB/DM 10'-28.5'; Autohammer**



## LOG OF TEST BORING

Project **Proposed Highland Manor Storm Shelter**  
Manor Drive  
Location **Madison, Wisconsin**

Boring No. **B-2**  
Surface Elevation (ft) **864.7**  
Job No. **C13064-8**  
Sheet **1** of **1**

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

| SAMPLE |      |              |       |       | VISUAL CLASSIFICATION<br>and Remarks  | SOIL PROPERTIES     |      |    |    |    |
|--------|------|--------------|-------|-------|---|---------------------|------|----|----|----|
| No.    | TYPE | Rec<br>(in.) | Moist | N     |   | qu<br>(qa)<br>(tsf) | W    | LL | PL | LI |
| 1      |      | 4            | M     | 30    | 3 in. TOPSOIL FILL (OL)<br>FILL: Medium Dense to Dense, Brown Fine to Medium Sand, Some Silt and Gravel   |                     |      |    |    |    |
| 2      |      | 10           | M     | 10    | Medium Stiff to Stiff, Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL)  | (2.0)               |      |    |    |    |
| 3      |      | 14           | M     | 4     |   | (0.5)               | 29.3 |    |    |    |
| 4      |      | 10           | MW    | 15    | Medium Dense, Brown/Gray (Mottled) SILT, Trace Sand, Scattered Sand Seams (ML)  |                     |      |    |    |    |
| 5      |      | 12           | W     | 20    | Medium Dense, Gray SILT, Trace Sand, Scattered Sand and Clay Seams (ML)   |                     | 22.4 |    |    |    |
| 6      |      | 7            | W     | 15    | Medium Dense, Brown Silty Fine to Medium SAND, Little Gravel, Trace Clay, Scattered Cobbles/Boulders (SM)   |                     |      |    |    |    |
| 7      |      | 10           | W     | 48    | Dense, Gray-Brown Fine SAND, Trace to Little Silt, Scattered Silt Seams (SP/SP-SM)  |                     |      |    |    |    |
| 8      |      | 4            | W     | 50/4" | Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM)<br>End of Boring/Split-Spoon Refusal at 29.5 ft<br>Borehole backfilled with bentonite slurry and chips |                     |      |    |    |    |

### WATER LEVEL OBSERVATIONS

While Drilling  $\nabla$  **13.5'** Upon Completion of Drilling \_\_\_\_\_  
Time After Drilling \_\_\_\_\_  
Depth to Water \_\_\_\_\_ **8'**  $\nabla$   
Depth to Cave in \_\_\_\_\_ **9.0'**

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

### GENERAL NOTES

Start **8/19/13** End **8/19/13**  
Driller **BSD** Chief **KD** Rig **D-120**  
Logger **JM/MG** Editor **DAS**  
Drill Method **2.25" HSA 0-15; 3-7/8"**  
**RB/DM 15'-29.5'; Autohammer**



## LOG OF TEST BORING

Project **Proposed Highland Manor Storm Shelter**  
Manor Drive  
Location **Madison, Wisconsin**

Boring No. **B-3**  
Surface Elevation (ft) **863.5**  
Job No. **C13064-8**  
Sheet **1** of **1**

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

| SAMPLE |      |              |       |    | VISUAL CLASSIFICATION<br>and Remarks  | SOIL PROPERTIES     |      |    |    |    |
|--------|------|--------------|-------|----|---|---------------------|------|----|----|----|
| No.    | TYPE | Rec<br>(in.) | Moist | N  |   | qu<br>(qa)<br>(tsf) | W    | LL | PL | LI |
|        |      |              |       |    | 8 in.± TOPSOIL FILL (OL)  |                     |      |    |    |    |
| 1      |      | 14           | M     | 30 | FILL: Medium Dense to Dense, Brown Fine to Medium Sand, Some Silt, Little Gravel                          |                     |      |    |    |    |
| 2      |      | 14           | M     | 12 | Stiff, Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL)  | (1.75)              |      |    |    |    |
| 3      |      | 12           | M     | 8  |   | (1.0-1.5)           |      |    |    |    |
| 4      |      | 16           | M/W   | 6  | Medium Stiff to Stiff, Brown Silty CLAY to Clayey SILT, Trace Sand (CL-ML/ML)                             | (0.5-1.5)           | 21.5 |    |    |    |
|        |      |              |       |    | Medium Dense, Gray SILT, Trace Sand, Scattered Sand Seams (ML)  |                     |      |    |    |    |
| 5      |      | 14           | W     | 14 | Medium Dense, Light Brown Fine SAND, Trace Silt, Scattered Silt Seams (SP)                                |                     |      |    |    |    |
|        |      |              |       |    | Loose, Brown/Gray (Mottled) SILT, Little to Some Sand, Scattered Sand Seams (ML)                          |                     |      |    |    |    |
| 6      |      | 14           | W     | 8  |   |                     |      |    |    |    |
|        |      |              |       |    | Medium Dense, Gray Silty Fine to Medium SAND, Little Gravel, Trace Clay, Scattered Cobbles/Boulders (SM)  |                     |      |    |    |    |
| 7      |      | 12           | W     | 14 |   |                     |      |    |    |    |
|        |      |              |       |    | Very Dense, Brown Fine to Coarse SAND, Some Gravel, Trace to Little Silt, Scattered Silt Seams (SP/SP-SM) |                     |      |    |    |    |
| 8      |      | 10           | W     | 53 |   |                     |      |    |    |    |
|        |      |              |       |    | End of Boring at 30 ft  |                     |      |    |    |    |
|        |      |              |       |    | Borehole backfilled with bentonite slurry and chips   |                     |      |    |    |    |

### WATER LEVEL OBSERVATIONS

### GENERAL NOTES

While Drilling  $\nabla$  **8.5'** Upon Completion of Drilling \_\_\_\_\_  
Time After Drilling \_\_\_\_\_  
Depth to Water \_\_\_\_\_  
Depth to Cave in \_\_\_\_\_

Start **8/19/13** End **8/19/13**  
Driller **BSD** Chief **AP** Rig **D-120**  
Logger **JF** Editor **DAS**  
Drill Method **2.25" HSA 0-15; 3-7/8"**  
**RB/DM 15'-30'; Autohammer**

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



# LOG OF TEST BORING

Project **Proposed Highland Manor Storm Shelter**  
**Manor Drive**  
 Location **Madison, Wisconsin**

Boring No. **B-4**  
 Surface Elevation (ft) **864.6**  
 Job No. **C13064-8**  
 Sheet **1** of **1**

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

| SAMPLE |              |       |    |  | Depth<br>(ft) | VISUAL CLASSIFICATION<br>and Remarks   | SOIL PROPERTIES     |      |    |    |    |
|--------|--------------|-------|----|--|---------------|--|---------------------|------|----|----|----|
| No.    | Rec<br>(in.) | Moist | N  |  |               |  | qu<br>(qa)<br>(tsf) | W    | LL | PL | LI |
| 1      | 13           | M     | 15 |  |               | 2 in. TOPSOIL FILL (OL)<br>FILL: Medium Dense, Brown Fine to Medium Sand, Some Silt and Gravel               |                     |      |    |    |    |
| 2      | 10           | M     | 9  |  |               | Medium Stiff to Stiff, Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL)                                       | (2.0)               |      |    |    |    |
| 3      | 14           | M/W   | 5  |  |               |  | (0.5-0.75)          | 26.9 |    |    |    |
| 4      | 10           | W     | 16 |  |               | Medium Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel, Scattered Silt Seams (SP/SP-SM) |                     |      |    |    |    |
| 5      | 18           | W     | 11 |  |               | Medium Dense, Brown SILT, Trace Sand, Scattered Sand Seams (ML)  | (0.5-1.0)           |      |    |    |    |
| 6      | 16           | W     | 13 |  |               | Color Changes to Gray Near 20 ft   | (0.5-1.0)           |      |    |    |    |
| 7      | 8            | W     | 21 |  |               | Medium Dense, Gray Silty Fine to Medium SAND, Little Gravel and Clay, Scattered Cobbles/Boulders (SM)        |                     |      |    |    |    |
| 8      | 4            | W     | 32 |  |               | Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM)                      |                     |      |    |    |    |
|        |              |       |    |  |               | End of Boring/Auger Refusal at 30 ft<br>Borehole backfilled with bentonite chips                             |                     |      |    |    |    |

## WATER LEVEL OBSERVATIONS

## GENERAL NOTES

While Drilling ☒ **8.5'** Upon Completion of Drilling \_\_\_\_\_  
 Time After Drilling \_\_\_\_\_  
 Depth to Water \_\_\_\_\_  
 Depth to Cave in \_\_\_\_\_

Start **8/19/13** End **8/19/13**  
 Driller **BSD** Chief **KD** Rig **D-120**  
 Logger **JM/MG** Editor **DAS**  
 Drill Method **2.25" HSA 0-10; 3-7/8"**  
**RB/DM 10'-30'; Autohammer**

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



## LOG OF TEST BORING

Project **Proposed Highland Manor Storm Shelter**  
Manor Drive  
Location **Madison, Wisconsin**

Boring No. **B-5**  
Surface Elevation (ft) **864.1**  
Job No. **C13064-8**  
Sheet **1** of **1**

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

| SAMPLE |              |       |    |               | VISUAL CLASSIFICATION<br>and Remarks   | SOIL PROPERTIES     |      |    |    |    |
|--------|--------------|-------|----|---------------|--|---------------------|------|----|----|----|
| No.    | Rec<br>(in.) | Moist | N  | Depth<br>(ft) |  | qu<br>(qa)<br>(tsf) | W    | LL | PL | LI |
|        |              |       |    |               | 6.5 in. ± TOPSOIL FILL (OL)  |                     |      |    |    |    |
| 1      | 12           | M     | 24 |               | FILL: Medium Dense, Brown Fine to Medium Sand, Some Silt, Little Gravel                                  |                     |      |    |    |    |
| 2      | 12           | M     | 9  |               | Medium Stiff to Stiff, Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL)                                   | (1.75)              |      |    |    |    |
| 3      | 14           | M     | 5  |               |  | (0.75-1.0)          | 27.2 |    |    |    |
| 4      | 16           | M/W   | 8  |               | Loose, Gray/Brown (Mottled) SILT to Clayey SILT, Trace Sand (ML)   | (0.5-1.0)           | 20.8 | 23 | 18 |    |
|        |              |       |    |               |  |                     |      |    |    |    |
| 5      | 16           | W     | 9  |               |  | (1.0-1.25)          |      |    |    |    |
|        |              |       |    |               | Scattered Clay Seams Near 15 ft  |                     |      |    |    |    |
| 6      | 16           | W     | 11 |               |  | (1.5-2.25)          |      |    |    |    |
|        |              |       |    |               | Color Changes to Gray with Scattered Sand Seams Near 20 ft   |                     |      |    |    |    |
| 7      | 12           | W     | 29 |               | Medium Dense, Gray Silty Fine to Medium SAND, Little Gravel, Trace Clay, Scattered Cobbles/Boulders (SM) |                     |      |    |    |    |
|        |              |       |    |               |  |                     |      |    |    |    |
|        |              |       |    |               | Dense, Brown Fine to Medium SAND, Trace to Little Silt, Trace Gravel (SP/SP-SM)                          |                     |      |    |    |    |
| 8      | 8            | W     | 45 |               |  |                     |      |    |    |    |
|        |              |       |    |               | End of Boring at 30 ft   |                     |      |    |    |    |
|        |              |       |    |               | Borehole backfilled with bentonite slurry and chips  |                     |      |    |    |    |

### WATER LEVEL OBSERVATIONS

### GENERAL NOTES

While Drilling  $\nabla$  **9.0'** Upon Completion of Drilling \_\_\_\_\_  
Time After Drilling \_\_\_\_\_  
Depth to Water \_\_\_\_\_  
Depth to Cave in \_\_\_\_\_

Start **8/19/13** End **8/19/13**  
Driller **BSD** Chief **AP** Rig **D-120**  
Logger **JF** Editor **DAS**  
Drill Method **2.25" HSA 0-10; 3-7/8"**  
**RB/DM; Autohammer**

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



## LOG OF TEST BORING

Project **Proposed Highland Manor Storm Shelter**  
Manor Drive  
Location **Madison, Wisconsin**

Boring No. **A-1**  
Surface Elevation (ft) **867.8**  
Job No. **C13064-8**  
Sheet **1** of **1**

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

| SAMPLE |      |              |       |    | VISUAL CLASSIFICATION<br>and Remarks |   | SOIL PROPERTIES |                     |   |    |    |
|--------|------|--------------|-------|----|--------------------------------------|---|-----------------|---------------------|---|----|----|
| No.    | TYPE | Rec<br>(in.) | Moist | N  |                                      |   | Depth<br>(ft)   | qu<br>(qa)<br>(tsf) | W | LL | PL |
| 1      |      | 6            | M     | 7  |                                      | 3 in. ± TOPSOIL FILL (OL)<br>FILL: Stiff, Brown Lean Clay, Some Sand, Trace Gravel          | (1.5)           |                     |   |    |    |
| 2      |      | 10           | M     | 9  |                                      | Stiff to Very Stiff, Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL)                        | (2.0)           |                     |   |    |    |
| 3      |      | 14           | M/W   | 10 |                                      | Soft to Medium Stiff, Brown/Gray Silty CLAY to Clayey SILT (Mottled), Trace Sand (CL-ML/ML) | (0.5)           | 21.0                |   |    |    |
| 4      |      | 16           | W     | 11 |                                      | Medium Dense, Brown Silty Fine SAND, Trace Gravel and Clay, Scattered Cobbles/Boulders (SM) |                 |                     |   |    |    |
|        |      |              |       |    | 10                                   | End of Boring at 10 ft  |                 |                     |   |    |    |
|        |      |              |       |    |                                      | Borehole backfilled with bentonite chips  |                 |                     |   |    |    |
|        |      |              |       |    | 15                                   |   |                 |                     |   |    |    |
|        |      |              |       |    | 20                                   |   |                 |                     |   |    |    |
|        |      |              |       |    | 25                                   |   |                 |                     |   |    |    |
|        |      |              |       |    | 30                                   |   |                 |                     |   |    |    |
|        |      |              |       |    | 35                                   |   |                 |                     |   |    |    |

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



## LOG OF TEST BORING

Project **Proposed Highland Manor Storm Shelter**  
**Manor Drive**  
Location **Madison, Wisconsin**

Boring No. **A-3**  
Surface Elevation (ft) **866.6**  
Job No. **C13064-8**  
Sheet **1** of **1**

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

| SAMPLE |      |              |       |    | VISUAL CLASSIFICATION<br>and Remarks | SOIL PROPERTIES   |                     |   |    |    |    |
|--------|------|--------------|-------|----|--------------------------------------|---|---------------------|---|----|----|----|
| No.    | TYPE | Rec<br>(in.) | Moist | N  |                                      | Depth<br>(ft)   | qu<br>(qa)<br>(tsf) | W | LL | PL | LI |
|        |      |              |       |    |                                      | 5 in. ± TOPSOIL FILL (OL)   |                     |   |    |    |    |
| 1      |      | 16           | M     | 26 |                                      | FILL: Medium Dense, Brown Fine to Medium Sand, Some Silt, Little Gravel, Scattered Clay Pockets |                     |   |    |    |    |
| 2      |      | 5            | M     | 9  |                                      | Stiff, Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL)  | (2.0)               |   |    |    |    |
| 3      |      | 16           | M     | 5  |                                      |   | (1.0)               |   |    |    |    |
| 4      |      | 10           | M/W   | 8  |                                      | Loose, Gray/Brown (Mottled) SILT to Clayey SILT, Trace Sand (ML)                                | (1.0)               |   |    |    |    |
| 10     |      |              |       |    |                                      | End of Boring at 10 ft  |                     |   |    |    |    |
|        |      |              |       |    |                                      | Borehole Backfilled bentonite chips   |                     |   |    |    |    |
| 15     |      |              |       |    |                                      |   |                     |   |    |    |    |
| 20     |      |              |       |    |                                      |   |                     |   |    |    |    |
| 25     |      |              |       |    |                                      |   |                     |   |    |    |    |
| 30     |      |              |       |    |                                      |   |                     |   |    |    |    |
| 35     |      |              |       |    |                                      |   |                     |   |    |    |    |

### WATER LEVEL OBSERVATIONS

### GENERAL NOTES

While Drilling ☒ NW Upon Completion of Drilling 15 Min.  
Time After Drilling NW  
Depth to Water 7.5'  
Depth to Cave in

Start 8/19/13 End 8/19/13  
Driller BSD Chief KD Rig D-120  
Logger JM/MG Editor DAS  
Drill Method 2.25" HSA; Autohammer

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



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




## LOG OF TEST BORING

Project **Proposed Highland Manor Storm Shelter**  
**Manor Drive**  
Location **Madison, Wisconsin**

Boring No. **A-5**  
Surface Elevation (ft) **864.0**  
Job No. **C13064-8**  
Sheet **1** of **1**

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

| SAMPLE |      |              |       |    | VISUAL CLASSIFICATION<br>and Remarks   | SOIL PROPERTIES   |                     |   |    |    |    |
|--------|------|--------------|-------|----|--|---|---------------------|---|----|----|----|
| No.    | TYPE | Rec<br>(in.) | Moist | N  |  | Depth<br>(ft)   | qu<br>(qa)<br>(tsf) | W | LL | PL | LI |
| 1      |      | 13           | M     | 22 |    | 3 in. ± TOPSOIL FILL (OL)<br>USDA: 10YR 2/2 Silt Loam   |                     |   |    |    |    |
| 2      |      | 12           | M     | 10 |  | FILL: Medium Dense, Brown Fine to Medium Sand, Some Silt, Little Gravel<br>FILL - 10YR 5/4 Sandy Loam   | (1.5-2.0)           |   |    |    |    |
| 3      |      | 12           | W     | 9  |  | Stiff, Gray/Brown (Mottled) Lean CLAY, Trace Sand (CL)<br>USDA: 10YR 6/2 Silty Clay Loam (Redox: C2D 10YR 6/8)                                |                     |   |    |    |    |
| 4      |      | 15           | W     | 22 |  | Loose, Dark Brown CLAY, Fine Sand, Trace Gravel, Scattered Clay Seams (SC)<br>USDA: 10YR 3/2 Sandy Clay Loam, Scattered Silty Clay Loam Seams | (1.0)               |   |    |    |    |
|        |      |              |       |    | Medium Dense, Gray/Brown (Mottled) SILT to Clayey SILT, Trace Sand, Scattered Sand Seams (ML)<br>USDA: 10YR 6/2 Silt Loam (Redox C2D 10YR 6/6) |   |                     |   |    |    |    |
|        |      |              |       |    | Medium Dense, Brown Fine to Medium Sand, Some Silt and Gravel (SM)<br>USDA: 10YR 5/6 Sandy Loam  |   |                     |   |    |    |    |
|        |      |              |       |    | End of Boring at 10 ft   |   |                     |   |    |    |    |
|        |      |              |       |    | Borehole backfilled with bentonite chips   |   |                     |   |    |    |    |

### WATER LEVEL OBSERVATIONS

While Drilling ▽ 6.0' Upon Completion of Drilling 15 Min.  
Time After Drilling NW ▽  
Depth to Water 7.5'  
Depth to Cave in

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

### GENERAL NOTES

Start 8/19/13 End 8/19/13  
Driller BSD Chief KD Rig D-120  
Logger JM/MG Editor DAS  
Drill Method 2.25" HSA; Autohammer

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

[illegible]

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

| SAMPLE |      |              |       |    | VISUAL CLASSIFICATION<br>and Remarks   | SOIL PROPERTIES |                     |   |    |    |    |
|--------|------|--------------|-------|----|--|-----------------|---------------------|---|----|----|----|
| No.    | TYPE | Rec<br>(in.) | Moist | N  |  | Depth<br>(ft)   | qu<br>(qa)<br>(tsf) | W | LL | PL | LI |
| 1      |      | 10           | M     | 11 | <p>3 in. ± TOPSOIL FILL (OL)<br/>USDA: 10YR 2/2 Silt Loam<br/>Stiff, Gray to Gray/Brown (Mottled) Lean CLAY,<br/>Trace Sand (CL)<br/>USDA: 10YR 4/3 to 10YR 6/2 Silty Clay Loam<br/>(Redox: C2D 10YR 6/8)</p> <p>Medium Dense, Gray/Brown (Mottled) SILT to<br/>Clayey SILT, Trace Sand, Scattered Sand Seams<br/>(ML)<br/>USDA: 10YR 6/2 Silt Loam (Redox C2D 10YR<br/>6/6)</p> <p>End of Boring at 10 ft</p> <p>Borehole Backfilled with bentonite chips</p> | (2.0)           |                     |   |    |    |    |
| 2      |      | 14           | M     | 9  |  | (1.5)           |                     |   |    |    |    |
| 3      |      | 10           | M     | 12 |  | (1.25)          |                     |   |    |    |    |
| 4      |      | 7            | M     | 12 |  | (2.0)           |                     |   |    |    |    |

## WATER LEVEL OBSERVATIONS

## GENERAL NOTES

| While Drilling      | Upon Completion of Drilling |  |  | 15 Min. |
|---------------------|-----------------------------|--|--|---------|
| Time After Drilling |                             |  |  |         |
| Depth to Water      |                             |  |  | 7.7'    |
| Depth to Cave in    |                             |  |  | 7.9'    |

Start **8/19/13** End **8/19/13**  
 Driller **BSD** Chief **KD** Rig **D-120**  
 Logger **JM/MG** Editor **DAS**  
 Drill Method **2.25" HSA; Autohammer**

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

## LOG OF TEST BORING

### General Notes

### DESCRIPTIVE SOIL CLASSIFICATION

#### Grain Size Terminology

| Soil Fraction       | Particle Size               | U.S. Standard Sieve Size |
|---------------------|-----------------------------|--------------------------|
| Boulders .....      | Larger than 12" .....       | Larger than 12"          |
| Cobbles.....        | 3" to 12" .....             | 3" to 12"                |
| Gravel: Coarse..... | ¾" to 3" .....              | ¾" to 3"                 |
| Fine.....           | 4.76 mm to ¾" .....         | #4 to ¾"                 |
| Sand: Coarse.....   | 2.00 mm to 4.76 mm.....     | #10 to #4                |
| Medium .....        | 0.42 to mm to 2.00 mm.....  | #40 to #10               |
| Fine.....           | 0.074 mm to 0.42 mm.....    | #200 to #40              |
| Silt.....           | 0.005 mm to 0.074 mm.....   | Smaller than #200        |
| Clay .....          | Smaller than 0.005 mm ..... | Smaller than #200        |

Plasticity characteristics differentiate between silt and clay.

#### General Terminology

Physical Characteristics  
Color, moisture, grain shape, fineness, etc.  
Major Constituents  
Clay, silt, sand, gravel  
Structure  
Laminated, varved, fibrous, stratified,  
cemented, fissured, etc.  
Geologic Origin  
Glacial, alluvial, eolian, residual, etc.

#### Relative Density

| Term              | "N" Value |
|-------------------|-----------|
| Very Loose.....   | 0 - 4     |
| Loose.....        | 4 - 10    |
| Medium Dense..... | 10 - 30   |
| Dense.....        | 30 - 50   |
| Very Dense.....   | Over 50   |

#### Relative Proportions Of Cohesionless Soils

| Proportional<br>Term | Defining Range by<br>Percentage of Weight |
|----------------------|---|
| Trace.....           | 0% - 5%                                   |
| Little .....         | 5% - 12%                                  |
| Some .....           | 12% - 35%                                 |
| And.....             | 35% - 50%                                 |

#### Organic Content by Combustion Method

| Soil Description          | Loss on Ignition |
|---------------------------|------------------|
| Non Organic.....          | Less than 4%     |
| Organic Silt/Clay.....    | 4 - 12%          |
| Sedimentary Peat.....     | 12% - 50%        |
| Fibrous and Woody Peat... | More than 50%    |

#### Consistency

| Term            | q <sub>u</sub> -tons/sq. ft |
|-----------------|-----------------------------|
| Very Soft.....  | 0.0 to 0.25                 |
| Soft.....       | 0.25 to 0.50                |
| Medium.....     | 0.50 to 1.0                 |
| Stiff.....      | 1.0 to 2.0                  |
| Very Stiff..... | 2.0 to 4.0                  |
| Hard.....       | Over 4.0                    |

#### Plasticity

| Term                 | Plastic Index |
|----------------------|---------------|
| None to Slight.....  | 0 - 4         |
| Slight.....          | 5 - 7         |
| Medium.....          | 8 - 22        |
| High to Very High .. | Over 22       |

The penetration resistance, N, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test.

## SYMBOLS

### Drilling and Sampling

CS – Continuous Sampling  
RC – Rock Coring: Size AW, BW, NW, 2"W  
RQD – Rock Quality Designation  
RB – Rock Bit/Roller Bit  
FT – Fish Tail  
DC – Drove Casing  
C – Casing: Size 2 ½", NW, 4", HW  
CW – Clear Water  
DM – Drilling Mud  
HSA – Hollow Stem Auger  
FA – Flight Auger  
HA – Hand Auger  
COA – Clean-Out Auger  
SS - 2" Dia. Split-Barrel Sample  
2ST – 2" Dia. Thin-Walled Tube Sample  
3ST – 3" Dia. Thin-Walled Tube Sample  
PT – 3" Dia. Piston Tube Sample  
AS – Auger Sample  
WS – Wash Sample  
PTS – Peat Sample  
PS – Pitcher Sample  
NR – No Recovery  
S – Sounding  
PMT – Borehole Pressuremeter Test  
VS – Vane Shear Test  
WPT – Water Pressure Test

### Laboratory Tests

q<sub>a</sub> – Penetrometer Reading, tons/sq ft  
q<sub>a</sub> – Unconfined Strength, tons/sq ft  
W – Moisture Content, %  
LL – Liquid Limit, %  
PL – Plastic Limit, %  
SL – Shrinkage Limit, %  
LI – Loss on Ignition  
D – Dry Unit Weight, lbs/cu ft  
pH – Measure of Soil Alkalinity or Acidity  
FS – Free Swell, %

### Water Level Measurement

▽ - Water Level at Time Shown  
NW – No Water Encountered  
WD – While Drilling  
BCR – Before Casing Removal  
ACR – After Casing Removal  
CW – Cave and Wet  
CM – Caved and Moist

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

# CGC, Inc.

Madison - Milwaukee

## UNIFIED SOIL CLASSIFICATION SYSTEM

### UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

| COARSE-GRAINED SOILS<br>(more than 50% of material is larger than No. 200 sieve size.) |  |  |
|--|--|--|
| <b>GRAVELS</b><br>More than 50% of coarse fraction larger than No. 4 sieve size        | Clean Gravels (Less than 5% fines)       |  |
|  | GW                                       | Well-graded gravels, gravel-sand mixtures, little or no fines  |
|  | GP                                       | Poorly-graded gravels, gravel-sand mixtures, little or no fines  |
|  | Gravels with fines (More than 12% fines) |  |
|  | GM                                       | Silty gravels, gravel-sand-silt mixtures   |
|  | GC                                       | Clayey gravels, gravel-sand-clay mixtures  |
| <b>SANDS</b><br>50% or more of coarse fraction smaller than No. 4 sieve size           | Clean Sands (Less than 5% fines)         |  |
|  | SW                                       | Well-graded sands, gravelly sands, little or no fines  |
|  | SP                                       | Poorly graded sands, gravelly sands, little or no fines  |
|  | Sands with fines (More than 12% fines)   |  |
|  | SM                                       | Silty sands, sand-silt mixtures  |
|  | SC                                       | Clayey sands, sand-clay mixtures   |
| FINE-GRAINED SOILS<br>(50% or more of material is smaller than No. 200 sieve size.)    |  |  |
| <b>SILTS AND CLAYS</b><br>Liquid limit less than 50%                                   | ML                                       | Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity |
|  | CL                                       | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays                  |
|  | OL                                       | Organic silts and organic silty clays of low plasticity  |
| <b>SILTS AND CLAYS</b><br>Liquid limit 50% or greater                                  | MH                                       | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts                                |
|  | CH                                       | Inorganic clays of high plasticity, fat clays  |
|  | OH                                       | Organic clays of medium to high plasticity, organic silts  |
| <b>HIGHLY ORGANIC SOILS</b>  | PT                                       | Peat and other highly organic soils  |

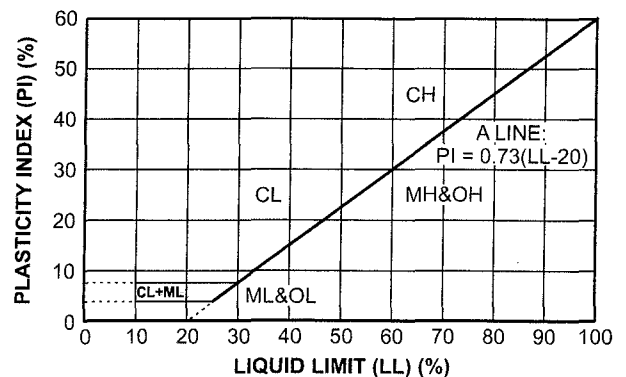
### LABORATORY CLASSIFICATION CRITERIA

|    |   |  |
|----|---|--|
| GW | $C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3 |  |
| GP | Not meeting all gradation requirements for GW   |  |
| GM | Atterberg limits below "A" line or P.I. less than 4   | Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols                  |
| GC | Atterberg limits above "A" line with P.I. greater than 7  |  |
| SW | $C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3 |  |
| SP | Not meeting all gradation requirements for GW   |  |
| SM | Atterberg limits below "A" line or P.I. less than 4   | Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols. |
| SC | Atterberg limits above "A" line with P.I. greater than 7  |  |

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP  
 More than 12 percent ..... GM, GC, SM, SC  
 5 to 12 percent ..... Borderline cases requiring dual symbols

### PLASTICITY CHART



## **APPENDIX C**

### **DOCUMENT QUALIFICATIONS**



## APPENDIX C

### DOCUMENT QUALIFICATIONS

---

#### I. GENERAL RECOMMENDATIONS/LIMITATIONS

---

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

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

---

#### II. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

---

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

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

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

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

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

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

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

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

#### SUBSURFACE CONDITIONS CAN CHANGE

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

#### MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL OPINION

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

## **A REPORT'S RECOMMENDATIONS ARE NOT FINAL**

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

## **A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION**

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

## **DO NOT REDRAW THE ENGINEER'S LOGS**

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

## **GIVE CONTRACTORS A COMPLETE REPORT AND GUIDANCE**

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

## **READ RESPONSIBILITY PROVISIONS CLOSELY**

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

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

## **GEOENVIRONMENTAL CONCERNS ARE NOT COVERED**

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

## **OBTAIN PROFESSIONAL ASSISTANCE TO DEAL WITH MOLD**

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

## **RELY ON YOUR GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE**

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

Modified and reprinted with permission from:

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

## **APPENDIX D**

### **RECOMMENDED COMPACTED FILL SPECIFICATIONS**

## **APPENDIX D**

### **CGC, INC.**

#### **RECOMMENDED COMPACTED FILL SPECIFICATIONS**

##### **General Fill Materials**

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

##### **Special Fill Materials**

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

##### **Placement Method**

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

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

##### **Compaction Specifications**

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

##### **Testing Procedures**

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

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

**Table 1**  
**Gradation of Special Fill Materials**

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

**Notes:**

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

**Table 2**  
**Compaction Guidelines**

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

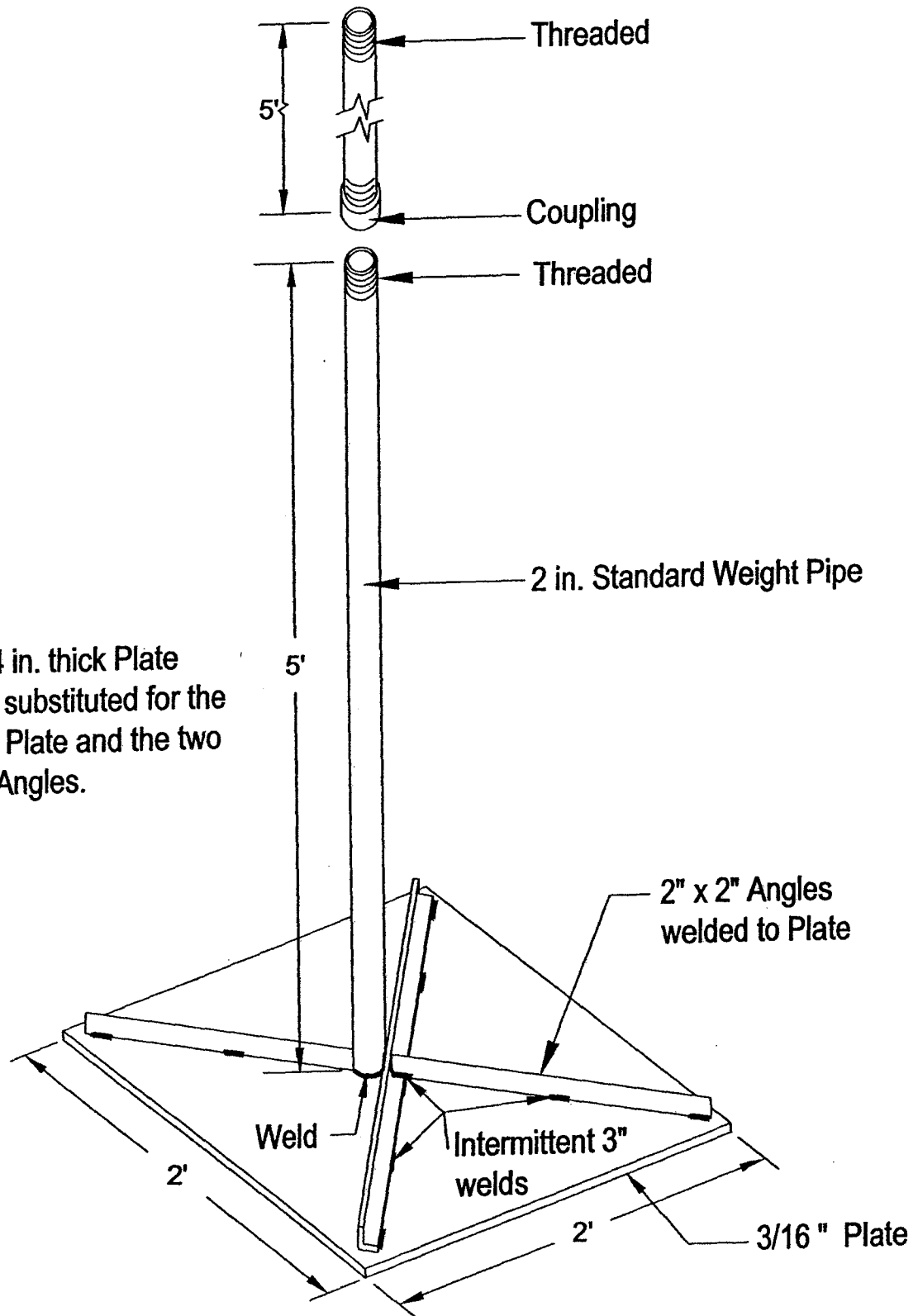
**Notes:**

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

## **APPENDIX E**

### **SETTLEMENT PLATFORM**

One 3/4 in. thick Plate  
may be substituted for the  
3/16 in. Plate and the two  
2" x 2" Angles.



CGC, Inc.

Typical Detail  
Settlement Platform

## **Settlement Platform Instructions**

Settlement platforms will be placed as close to the bottom of the fill as is practical. The surface upon which the settlement platform should rest must be cleaned off to a flat compacted surface. The settlement platform should then be placed in this surface and backfill should be placed over the top of the settlement platform to a depth of at least two feet.

Initial elevations should be taken on the top of the first section of the pipe riser. These should be referenced to the elevation at the platform so that all future additional lengths of riser pipe can be referenced to the elevation of the platform.

The settlement platform locations should be guarded with tall stakes driven into the fill marked with red flags. No equipment should be permitted to operate closer than three feet from the riser pipes. As each layer of fill is being added to the area, fill should be carefully placed around the riser pipe to an elevation slightly above the surrounding area. The vibrating compactor then should be moved to within a foot or so of the riser pipe with care being taken so as to avoid disturbance of the riser pipe. If necessary, hand compacting equipment should be used to avoid damage to the riser pipe.

When settlement platform readings are taken, the elevation of nearby fill should also be taken.

The elevation at the settlement platform and the nearby fill should be observed at least once each week, and during the period that fill is being placed in the vicinity of the platform, these elevations should be obtained daily. All elevation data should be plotted according to time, with one graph prepared per settlement platform. The plotting should contain the time scale along the abscissa and the vertical scale should be height of fill shown going upward from the middle of the paper, and the settlement of the settlement platforms should be plotted downward from the middle of the paper. The time scale should include both the actual calendar date and also the number of days since the platform was installed.

The benchmark to be used in reading the various settlement platforms should be well away from the proposed excavation or filling areas.

If damage occurs to any settlement platform riser pipe, it is suggested that the pipe be repaired as quickly as possible and the readings continued. The adjustment of these readings can be made, considering that settlement rate during the period of damage was uniform.



**APPENDIX F**

**WISCONSIN DEPARTMENT OF SAFETY & PROFESSIONAL SERVICES  
SOIL EVALUATION FORMS (4 BORINGS)**

# SOIL EVALUATION - STORM

in accordance with Comm 82.365 & 85, Wis. Adm. Code

Page 1 of 2

Attach complete site plan on paper not less than 8 1/2 x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent slope, scale or dimensions, north arrow, and BM referenced to nearest road.

Please print all information.

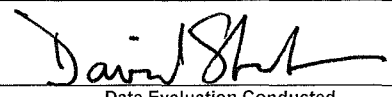
Personal information you provide may be used for secondary purposes (Privacy Law, s.15.04 (1) (m)).

|  |                    |                          |                     |  |                                  |                               |  |
|--|--------------------|--------------------------|---------------------|--|----------------------------------|-------------------------------|--|
| <b>Property Owner</b><br>City of Madison, Management Section                         |                    |                          |                     | <b>Property Location</b><br>Govt. Lot 1/4 NE 1/4 S T N R E<br>Lot # Block # Subd. Name or CSM# |                                  |                               |  |
| <b>Property Owner's Mailing Address</b><br>210 Martin Luther King Jr. Blvd, Room 115 |                    |                          |                     |  |                                  |                               |  |
| <b>City</b><br>Madison   | <b>State</b><br>WI | <b>Zip Code</b><br>53703 | <b>Phone Number</b> | <input checked="" type="checkbox"/> City   | <input type="checkbox"/> Village | <input type="checkbox"/> Town | <b>Nearest Road</b><br>Madison Manor Drive |

|   |  |
|---|--|
| <b>Drainage area</b> _____ sq. ft. <input type="checkbox"/> acres<br><b>Optional:</b><br><b>Test Site Suitable for (check all that apply)</b><br><input type="checkbox"/> Irrigation <input type="checkbox"/> Bioretention trench <input type="checkbox"/> Trench(es)<br><input type="checkbox"/> Rain Garden <input type="checkbox"/> Grassed Swale <input type="checkbox"/> Reuse<br><input type="checkbox"/> Infiltration trench <input type="checkbox"/> SDS (>15' wide) <input type="checkbox"/> Other _____ | <b>Hydraulic Application Test Method</b><br><input checked="" type="checkbox"/> Morphological Evaluation<br><input type="checkbox"/> Double-Ring Infiltrometer<br><input type="checkbox"/> Other (Specify) _____ |
|---|--|

|   |                  |  |  |  |                              |                    |                 |                     |                  |                            |
|---|------------------|--|--|--|------------------------------|--------------------|-----------------|---------------------|------------------|----------------------------|
| <b>A-5</b>  | <b>Obs. #</b>    | <input checked="" type="checkbox"/> Boring<br><input type="checkbox"/> Pit | <b>Ground Surface Elev.</b> 864 ft           | <b>Depth to limiting factor</b> 42 in. |                              |                    |                 |                     |                  | <b>Hydraulic App. Rate</b> |
| <b>Horizon</b>  | <b>Depth in.</b> | <b>Dominant Color Munsell</b>  | <b>Redox Description Qu. Sz. Cont. Color</b> | <b>Texture</b>                         | <b>Structure Gr. Sz. Sh.</b> | <b>Consistence</b> | <b>Boundary</b> | <b>% Rock Frag.</b> | <b>Inches/Hr</b> |                            |
| 1   | 0 - 3            | 10 YR 2/2  | None   | Fill-SiL                               | Variable                     | Variable           | gs              | <5                  | 0.13             |                            |
| 2   | 3 - 42           | 10 YR 5/4  | None   | Fill-SL                                | Variable                     | Variable           | as              | 10 - 15             | 0.5              |                            |
| 3   | 42 - 72          | 10 YR 6/2  | C2D 10YR6/8                                  | SiCL                                   | 1msbk                        | mvfr               | gs              | <5                  | 0.04             |                            |
| 4   | 72 - 102         | 10 YR 3/2  | None   | SCL/SiCL                               | 1msbk                        | mvfr               | gs              | <5                  | 0.04             |                            |
| 5   | 102 - 114        | 10 YR 6/2  | C2D 10YR6/6                                  | SiL                                    | 0m                           | mvfr               | gs              | <5                  | 0.13             |                            |
| 6   | 114 - 120        | 10 YR 5/6  | None   | SL                                     | 1msbk                        | mvfr               |                 | 10 - 15             | 0.5              |                            |
| Groundwater was encountered in the boring at 72 in. below existing site grades during drilling. |                  |  |  |  |                              |                    |                 |                     |                  |                            |

|  |                  |  |  |  |                              |                    |                 |                     |                  |                            |
|--|------------------|--|--|--|------------------------------|--------------------|-----------------|---------------------|------------------|----------------------------|
| <b>A-6</b>   | <b>Obs. #</b>    | <input checked="" type="checkbox"/> Boring<br><input type="checkbox"/> Pit | <b>Ground Surface Elev.</b> 862.5 ft         | <b>Depth to limiting factor</b> 30 in. |                              |                    |                 |                     |                  | <b>Hydraulic App. Rate</b> |
| <b>Horizon</b>   | <b>Depth in.</b> | <b>Dominant Color Munsell</b>  | <b>Redox Description Qu. Sz. Cont. Color</b> | <b>Texture</b>                         | <b>Structure Gr. Sz. Sh.</b> | <b>Consistence</b> | <b>Boundary</b> | <b>% Rock Frag.</b> | <b>Inches/Hr</b> |                            |
| 1  | 0 - 7.5          | 10 YR 2/2  | None   | Fill-SiL                               | Variable                     | Variable           | gs              | <5                  | 0.13             |                            |
| 2  | 7.5 - 30         | 10 YR 5/4  | None   | Fill-SL                                | Variable                     | Variable           | as              | 10 - 15             | 0.5              |                            |
| 3  | 30 - 96          | 10 YR 6/2  | C2D 10YR6/8                                  | SiCL                                   | 1msbk                        | mvfr               | gs              | <5                  | 0.04             |                            |
| 4  | 96 - 120         | 10 YR 6/2  | C2D 10YR6/6                                  | SiL                                    | 0m                           | mvfr               |                 | <5                  | 0.13             |                            |
| Groundwater was encountered in the boring at 108 in. below existing site grades during drilling. |                  |  |  |  |                              |                    |                 |                     |                  |                            |

|  |  |   |
|--|--|---|
| <b>CST/PSS Name (Please Print)</b><br>DAVID A STAAB          | <b>Signature</b><br> | <b>CST/PSS Number</b><br>1042602                              |
| <b>Address</b><br>3911 MINERAL POINT ROAD, MADISON, WI 53705 | <b>Date Evaluation Conducted</b><br>8/21/2013  | <b>Telephone Number</b><br>608/279-4530<br>SBD-10793 (R.1/05) |



## SECTION E: BIDDERS ACKNOWLEDGEMENT

### HIGHLAND MANOR STORM SHELTER (BUILDING COMPONENT) CONTRACT NO. 7343

Bidder must state a Unit Price and Total Bid for each item. The Total Bid for each item must be the product of quantity, by Unit Price. The Grand Total must be the sum of the Total Bids for the various items. In case of multiplication errors or addition errors, the Grand Total with corrected multiplication and/or addition shall determine the Grand Total bid for each contract. The Unit Price and Total Bid must be entered numerically in the spaces provided. All words and numbers shall be written in ink.

1. The undersigned having familiarized himself/herself with the Contract documents, including Advertisement for Bids, Instructions to Bidders, Form of Proposal, City of Madison Standard Specifications for Public Works Construction - 2014 Edition thereto, Form of Agreement, Form of Bond, and Addenda issued and attached to the plans and specifications on file in the office of the City Engineer, hereby proposes to provide and furnish all the labor, materials, tools, and expendable equipment necessary to perform and complete in a workmanlike manner the specified construction on this project for the City of Madison; all in accordance with the plans and specifications as prepared by the City Engineer, including Addenda to the Contract Nos. \_\_\_\_\_ through \_\_\_\_\_ issued thereto, at the prices for said work as contained in this proposal. (Electronic bids submittals shall acknowledge addendum under Section E and shall not acknowledge here)
2. If awarded the Contract, we will initiate action within seven (7) days after notification or in accordance with the date specified in the contract to begin work and will proceed with diligence to bring the project to full completion within the number of work days allowed in the Contract or by the calendar date stated in the Contract.
3. The undersigned Bidder or Contractor certifies that he/she is not a party to any contract, combination in form of trust or otherwise, or conspiracy in restraint of trade or commerce or any other violation of the anti-trust laws of the State of Wisconsin or of the United States, with respect to this bid or contract or otherwise.
4. I hereby certify that I have met the Bid Bond Requirements as specified in Section 102.5.  
*(IF BID BOND IS USED, IT SHALL BE SUBMITTED ON THE FORMS PROVIDED BY THE CITY. FAILURE TO DO SO MAY RESULT IN REJECTION OF THE BID).*
5. I hereby certify that all statements herein are made on behalf of \_\_\_\_\_ (name of corporation, partnership, or person submitting bid) a corporation organized and existing under the laws of the State of \_\_\_\_\_ a partnership consisting of \_\_\_\_\_; an individual trading as \_\_\_\_\_; of the City of \_\_\_\_\_ State of \_\_\_\_\_; that I have examined and carefully prepared this Proposal, from the plans and specifications and have checked the same in detail before submitting this Proposal; that I have fully authority to make such statements and submit this Proposal in (its, their) behalf; and that the said statements are true and correct.

\_\_\_\_\_  
SIGNATURE

\_\_\_\_\_  
TITLE, IF ANY

Sworn and subscribed to before me this  
\_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

\_\_\_\_\_  
(Notary Public or other officer authorized to administer oaths)

My Commission Expires \_\_\_\_\_

Bidders shall not add any conditions or qualifying statements to this Proposal.

## SECTION F: DISCLOSURE OF OWNERSHIP & BEST VALUE CONTRACTING

### HIGHLAND MANOR STORM SHELTER (BUILDING COMPONENT) CONTRACT NO. 7343

State of Wisconsin  
Department of Workforce Development  
Equal Rights Division  
Labor Standards Bureau

### Disclosure of Ownership

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

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

#### Other Construction Business

**Not Applicable** ☐

Name of Business

Street Address or P O Box

City

State

Zip Code

Name of Business

Street Address or P O Box

City

State

Zip Code

Name of Business

Street Address or P O Box

City

State

Zip Code

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

Print the Name of Authorized Officer

Signature of Authorized Officer

Date Signed

Name of Corporation, Partnership or Sole Proprietorship

Street Address or P O Box

City

State

Zip Code

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

ERD-7777-E (R. 09/2003)

**HIGHLAND MANOR STORM SHELTER (BUILDING COMPONENT)  
CONTRACT NO. 7343**

**Best Value Contracting**

1. The Contractor shall indicate the non-apprenticeable trades used on this contract.

---

---

2. Madison General Ordinance (M.G.O.), 33.07(7), does provide for some exemptions from the active apprentice requirement. Apprenticeable trades are those trades considered apprenticeable by the State of Wisconsin. Please check applicable box if you are seeking an exemption.

- ☐ Contractor has a total skilled workforce of four or less individuals in all apprenticeable trades combined.
- ☐ No available trade training program; The Contractor has been rejected by the only available trade training program, or there is no trade training program within 90 miles.
- ☐ Contractor is not using an apprentice due to having a journey worker on layoff status, provided the journey worker was employed by the contractor in the past six months.
- ☐ First-time Contractor on City of Madison Public Works contract requests a onetime exemption but intends to comply on all future contracts and is taking steps typical of a "good faith" effort.
- ☐ Contractor has been in business less than one year.
- ☐ Contractor doesn't have enough journeyman trade workers to qualify for a trade training program in that respective trade

3. The Contractor shall indicate on the following section which apprenticeable trades are to be used on this contract. Compliance with active apprenticeship, to the extent required by M.G.O. 33.07(7), shall be satisfied by documentation from an applicable trade training body; an apprenticeship contract with the Wisconsin Department of Workforce Development or a similar agency in another state; or the U.S Department of Labor. This documentation is required prior to the Contractor beginning work on the project site.

- ☐ The Contractor has reviewed the list and shall not use any apprenticeable trades on this project.

**LIST APPRENTICABLE TRADES** (check all that apply to your work to be performed on this contract)

- ☐ BRICKLAYER
- ☐ CARPENTER
- ☐ CEMENT MASON / CONCRETE FINISHER
- ☐ CEMENT MASON (HEAVY HIGHWAY)
- ☐ CONSTRUCTION CRAFT LABORER
- ☐ DATA COMMUNICATION INSTALLER
- ☐ ELECTRICIAN
- ☐ ENVIRONMENTAL SYSTEMS TECHNICIAN / HVAC SERVICE TECH/HVAC INSTALL / SERVICE
- ☐ GLAZIER
- ☐ HEAVY EQUIPMENT OPERATOR / OPERATING ENGINEER
- ☐ INSULATION WORKER (HEAT & FROST)
- ☐ IRON WORKER
- ☐ IRON WORKER (ASSEMBLER, METAL BLDGS)
- ☐ PAINTER & DECORATOR
- ☐ PLASTERER
- ☐ PLUMBER
- ☐ RESIDENTIAL ELECTRICIAN
- ☐ ROOFER & WATER PROOFER
- ☐ SHEET METAL WORKER
- ☐ SPRINKLER FITTER
- ☐ STEAMFITTER
- ☐ STEAMFITTER (REFRIGERATION)
- ☐ STEAMFITTER (SERVICE)
- ☐ TAPER & FINISHER
- ☐ TELECOMMUNICATIONS (VOICE, DATA & VIDEO) INSTALLER-TECHNICIAN
- ☐ TILE SETTER

## SECTION G: BID BOND

KNOW ALL MEN BY THESE PRESENT, THAT \_\_\_\_\_ (a corporation of the State of \_\_\_\_\_) (individual), (partnership), hereinafter referred to as the "Principal") and \_\_\_\_\_, a corporation of the State of \_\_\_\_\_ (hereinafter referred to as the "Surety") and licensed to do business in the State of Wisconsin, are held and firmly bound unto the City of Madison, (hereinafter referred to as the "Obligee"), in the sum of five per cent (5%) of the amount of the total bid or bids of the Principal herein accepted by the Obligee, for the payment of which the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

The conditions of this obligation are such that, whereas the Principal has submitted, to the City of Madison a certain bid, including the related alternate, and substitute bids attached hereto and hereby made a part hereof, to enter into a contract in writing for the construction of:

### **HIGHLAND MANOR STORM SHELTER (BUILDING COMPONENT) CONTRACT NO. 7343**

1. If said bid is rejected by the Obligee, then this obligation shall be void.
2. If said bid is accepted by the Obligee and the Principal shall execute and deliver a contract in the form specified by the Obligee (properly completed in accordance with said bid) and shall furnish a bond for his/her faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said bid, then this obligation shall be void.

If said bid is accepted by the Obligee and the Principal shall fail to execute and deliver the contract and the performance and payment bond noted in 2. above executed by this Surety, or other Surety approved by the City of Madison, all within the time specified or any extension thereof, the Principal and Surety agree jointly and severally to forfeit to the Obligee as liquidated damages the sum mentioned above, it being understood that the liability of the Surety for any and all claims hereunder shall in no event exceed the sum of this obligation as stated, and it is further understood that the Principal and Surety reserve the right to recover from the Obligee that portion of the forfeited sum which exceed the actual liquidated damages incurred by the Obligee.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by an extension of the time within which the Obligee may accept such bid, and said Surety does hereby waive notice of any such extension.



IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, on the day and year set forth below.

Seal

\_\_\_\_\_  
Principal

\_\_\_\_\_  
Date

By:

\_\_\_\_\_

\_\_\_\_\_  
Name of Surety

By:

\_\_\_\_\_

\_\_\_\_\_  
Date

This certifies that I have been duly licensed as an agent for the above company in Wisconsin under License No. \_\_\_\_\_ for the year \_\_\_\_\_, and appointed as attorney in fact with authority to execute this bid bond and the payment and performance bond referred to above, which power of attorney has not been revoked.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Agent

\_\_\_\_\_  
Address

\_\_\_\_\_  
City, State and Zip Code

\_\_\_\_\_  
Telephone Number

#### NOTE TO SURETY & PRINCIPAL

The bid submitted which this bond guarantees shall be rejected if the following instrument is not attached to this bond:

Power of Attorney showing that the agent of Surety is currently authorized to execute bonds on behalf of the Surety, and in the amounts referenced above.

## Certificate of Biennial Bid Bond

|   |
|---|
| TIME PERIOD - VALID (FROM/TO)                               |
| NAME OF SURETY  |
| NAME OF CONTRACTOR  |
| CERTIFICATE HOLDER<br><div>City of Madison, Wisconsin</div> |

This is to certify that a biennial bid bond issued by the above-named Surety is currently on file with the City of Madison.

This certificate is issued as a matter of information and conveys no rights upon the certificate holder and does not amend, extend or alter the coverage of the biennial bid bond.

Cancellation: Should the above policy be cancelled before the expiration date, the issuing Surety will give thirty (30) days written notice to the certificate holder indicated above.

---

Signature of Authorized Contractor Representative

---

Date

## SECTION H: AGREEMENT

THIS AGREEMENT made this \_\_\_\_\_ day of \_\_\_\_\_ in the year Two Thousand and Fourteen between \_\_\_\_\_ hereinafter called the Contractor, and the City of Madison, Wisconsin, hereinafter called the City.

WHEREAS, the Common Council of the said City of Madison under the provisions of a resolution adopted \_\_\_\_\_, and by virtue of authority vested in the said Council, has awarded to the Contractor the work of performing certain construction.

NOW, THEREFORE, the Contractor and the City, for the consideration hereinafter named, agree as follows:

1. **Scope of Work.** The Contractor shall, perform the construction, execution and completion of the following listed complete work or improvement in full compliance with the Plans, Specifications, Standard Specifications, Supplemental Specifications, Special Provisions and contract; perform all items of work covered or stipulated in the proposal; perform all altered or extra work; and shall furnish, unless otherwise provided in the contract, all materials, implements, machinery, equipment, tools, supplies, transportation, and labor necessary to the prosecution and completion of the work or improvements:

### **HIGHLAND MANOR STORM SHELTER (BUILDING COMPONENT) CONTRACT NO. 7343**

2. **Completion Date/Contract Time.** Construction work must begin within seven (7) calendar days after the date appearing on mailed written notice to do so shall have been sent to the Contractor and shall be carried on at a rate so as to secure full completion SEE SPECIAL PROVISIONS, the rate of progress and the time of completion being essential conditions of this Agreement.
3. **Contract Price.** The City shall pay to the Contractor at the times, in the manner and on the conditions set forth in said specifications, the sum of \_\_\_\_\_ (\$ \_\_\_\_\_) Dollars being the amount bid by such Contractor and which was awarded to him/her as provided by law.

#### **4. Wage Rates for Employees of Public Works Contractors**

**General and Authorization.** The Contractor shall compensate its employees at the prevailing wage rate in accordance with section 66.0903, Wis. Stats., DWD 290 of the Wisconsin Administrative Code and Davis Bacon Act. In the event the State and Federal Rates are not identical, the higher of the two rates shall govern.

"Public Works" shall include building or work involving the erection, construction, remodeling, repairing or demolition of buildings, parking lots, highways, streets, bridges, sidewalks, street lighting, traffic signals, sanitary sewers, water mains and appurtenances, storm sewers, and the grading and landscaping of public lands.

"Building or work" includes construction activity as distinguished from manufacturing, furnishing of materials, or servicing and maintenance work, except for the delivery of mineral aggregate such as sand, gravel, bituminous asphaltic concrete or stone which is incorporated into the work under contract with the City by depositing the material directly in final place from transporting vehicle.

"Erection, construction, remodeling, repairing" means all types of work done on a particular building or work at the site thereof in the construction or development of the project, including without limitation, erecting, construction, remodeling, repairing, altering, painting, and decorating, the transporting of materials and supplies to or from the building or work done by the employees of the Contractor, Subcontractor, or Agent thereof, and the manufacturing or furnishing of

materials, articles, supplies or equipment on the site of the building or work, by persons employed by the Contractor, Subcontractor, or Agent thereof.

"Employees working on the project" means laborers, workers, and mechanics employed directly upon the site of work.

"Laborers, Workers, and Mechanics" include pre-apprentices, helpers, trainees, learners and properly registered and indentured apprentices but exclude clerical, supervisory, and other personnel not performing manual labor.

**Establishment of Wage Rates.** The Department of Public Works shall periodically obtain a current schedule of prevailing wage rates from DWD. The schedule shall be used to establish the City of Madison Prevailing Wage Rate Schedule for Public Works Construction (prevailing wage rate). The Department of Public Works may include known increases to the prevailing wage rate which can be documented and are to occur on a future specific date. The prevailing wage rate shall be included in public works contracts subsequently negotiated or solicited by the City. Except for known increases contained within the schedule, the prevailing wage rate shall not change during the contract. The approved wage rate is attached hereto.

**Workforce Profile.** The Contractor shall, at the time of signature of the contract, notify the City Engineer in writing of the names and classifications of all the employees of the Contractor, Subcontractors, and Agents proposed for the work. In the alternative, the Contractor shall submit in writing the classifications of all the employees of the Contractor, Subcontractors and Agents and the total number of hours estimated in each classification for the work. This workforce profile(s) shall be reviewed by the City Engineer who may, within ten (10) days, object to the workforce profile(s) as not being reflective of that which would be required for the work. The Contractor may request that the workforce profile, or a portion of the workforce profile, be submitted after the signature of the contract but at least ten (10) days prior to the work commencing. Any costs or time loss resulting from modifications to the workforce profile as a result of the City Engineer's objections shall be the responsibility of the Contractor.

**Payrolls and Records.** The Contractor shall keep weekly payroll records setting forth the name, address, telephone number, classification, wage rate and fringe benefit package of all the employees who work on the contract, including the employees of the Contractor's subcontractors and agents. Such weekly payroll records must include the required information for all City contracts and all other contracts on which the employee worked during the week in which the employee worked on the contract. The Contractor shall also keep records of the individual time each employee worked on the project and for each day of the project. Such records shall also set forth the total number of hours of overtime credited to each such employee for each day and week and the amount of overtime pay received in that week. The records shall set forth the full weekly wages earned by each employee and the actual hourly wage paid to the employee.

The Contractor shall submit the weekly payroll records, including the records of the Contractor's subcontractors and agents, to the City Engineer for every week that work is being done on the contract. The submittal shall be within twenty-one (21) calendar days of the end of the Contractor's weekly pay period.

Employees shall receive the full amounts accrued at the time of the payment, computed at rates not less than those stated in the prevailing wage rate and each employee's rate shall be determined by the work that is done within the trade or occupation classification which should be properly assigned to the employee.

An employee's classification shall not be changed to a classification of a lesser rate during the contract. If, during the term of the contract, an employee works in a higher pay classification than the one which was previously properly assigned to the employee, then that employee shall be considered to be in the higher pay classification for the balance of the contract, receive the appropriate higher rate of pay, and she/he shall not receive a lesser rate during the balance of the

contract. For purposes of clarification, it is noted that there is a distinct difference between working in a different classification with higher pay and doing work within a classification that has varying rates of pay which are determined by the type of work that is done within the classification. For example, the classification "Operating Engineer" provides for different rates of pay for various classes of work and the Employer shall compensate an employee classified as an "Operating Engineer" based on the highest class of work that is done in one day. Therefore, an "Operating Engineer's" rate may vary on a day to day basis depending on the type of work that is done, but it will never be less than the base rate of an "Operating Engineer". Also, as a matter of clarification, it is recognized that an employee may work in a higher paying classification merely by chance and without prior intention, calculation or design. If such is the case and the performance of the work is truly incidental and the occurrence is infrequent, inconsequential and does not serve to undermine the single classification principle herein, then it may not be required that the employee be considered to be in the higher pay classification and receive the higher rate of pay for the duration of the contract. However, the Contractor is not precluded or prevented from paying the higher rate for the limited time that an employee performs work that is outside of the employee's proper classification.

Questions regarding an employee's classification, rate of pay or rate of pay within a classification, shall be resolved by reference to the established practice that predominates in the industry and on which the trade or occupation rate/classification is based. Rate of pay and classification disputes shall be resolved by relying upon practices established by collective bargaining agreements and guidelines used in such determination by appropriate recognized trade unions operating within the City of Madison.

The Contractor, its Subcontractors and Agents shall submit to interrogation regarding compliance with the provisions of this ordinance.

Mulcting of the employees by the Contractor, Subcontractor, and Agents on Public Works contracts, such as by kickbacks or other devices, is prohibited. The normal rate of wage of the employees of the Contractor, Subcontractor, and Agents shall not be reduced or otherwise diminished as a result of payment of the prevailing wage rate on a public works contract.

**Hourly contributions.** Hourly contributions shall be determined in accordance with the prevailing wage rate and with DWD. 290.01(10), Wis. Admin. Code.

**Apprentices and Subjourney persons.** Apprentices and sub journeypersons performing work on the project shall be compensated in accordance with the prevailing wage rate and with DWD 290.02, and 290.025, respectively, Wis. Admin. Code.

**Straight Time Wages.** The Contractor may pay straight time wages as determined by the prevailing wage rate and DWD 290.04, Wis. Admin. Code.

**Overtime Wages.** The Contractor shall pay overtime wages as required by the prevailing wage rate and DWD 290.05, Wis. Admin. Code.

**Posting of Wage Rates and Hours.** A clearly legible copy of the prevailing wage rate, together with the provisions of Sec. 66.0903(10)(a) and (11)(a), Wis. Stats., shall be kept posted in at least one conspicuous and easily accessible place at the project site by the Contractor and such notice shall remain posted during the full time any laborers, workers or mechanics are employed on the contract.

**Evidence of Compliance by Contractor.** Upon completion of the contract, the Contractor shall file with the Department of Public Works an affidavit stating:

- a. That the Contractor has complied fully with the provisions and requirements of Sec. 66.0903(3), Wis. Stats., and Chapter DWD 290, Wis. Admin. Code; the Contractor has received evidence of compliance from each of the agents and subcontractors; and the

names and addresses of all of the subcontractors and agents who worked on the contract.

- b. That full and accurate records have been kept, which clearly indicate the name and trade or occupation of every laborer, worker or mechanic employed by the Contractor in connection with work on the project. The records shall show the number of hours worked by each employee and the actual wages paid therefore; where these records will be kept and the name, address and telephone number of the person who will be responsible for keeping them. The records shall be retained and made available for a period of at least three (3) years following the completion of the project of public works and shall not be removed without prior notification to the municipality.

**Evidence of Compliance by Agent and Subcontractor.** Each agent and subcontractor shall file with the Contractor, upon completion of their portion of the work on the contract an affidavit stating that all the provisions of Sec. 66.0903(3), Wis. Stats., have been fully complied with and that full and accurate records have been kept, which clearly indicate the name and trade or occupation of every laborer, worker or mechanic employed by the Contractor in connection with work on the project. The records shall show the number of hours worked by each employee and the actual wages paid therefore; where these records shall be kept and the name, address and telephone number of the person who shall be responsible for keeping them. The records shall be retained and made available for a period of at least three (3) years following the completion of the project of public works and shall not be removed without prior notification to the municipality.

**Failure to Comply with the Prevailing Wage Rate.** If the Contractor fails to comply with the prevailing wage rate, she/he shall be in default on the contract.

5. **Affirmative Action.** In the performance of the services under this Agreement the Contractor agrees not to discriminate against any employee or applicant because of race, religion, marital status, age, color, sex, disability, national origin or ancestry, income level or source of income, arrest record or conviction record, less than honorable discharge, physical appearance, sexual orientation, gender identity, political beliefs, or student status. The Contractor further agrees not to discriminate against any subcontractor or person who offers to subcontract on this contract because of race, religion, color, age, disability, sex, sexual orientation, gender identity or national origin.

The Contractor agrees that within thirty (30) days after the effective date of this agreement, the Contractor will provide to the City Affirmative Action Division certain workforce utilization statistics, using a form to be furnished by the City.

If the contract is still in effect, or if the City enters into a new agreement with the Contractor, within one year after the date on which the form was required to be provided, the Contractor will provide updated workforce information using a second form, also to be furnished by the City. The second form will be submitted to the City Affirmative Action Division no later than one year after the date on which the first form was required to be provided.

The Contractor further agrees that, for at least twelve (12) months after the effective date of this contract, it will notify the City Affirmative Action Division of each of its job openings at facilities in Dane County for which applicants not already employees of the Contractor are to be considered. The notice will include a job description, classification, qualifications and application procedures and deadlines. The Contractor agrees to interview and consider candidates referred by the Affirmative Action Division if the candidate meets the minimum qualification standards established by the Contractor, and if the referral is timely. A referral is timely if it is received by the Contractor on or before the date started in the notice.

Articles of Agreement  
Article I

The Contractor shall take affirmative action in accordance with the provisions of this contract to insure that applicants are employed, and that employees are treated during employment without regard to race, religion, color, age, marital status, disability, sex, sexual orientation, gender identity or national origin and that the employer shall provide harassment free work environment for the realization of the potential of each employee. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation and selection for training including apprenticeship insofar as it is within the control of the Contractor. The Contractor agrees to post in conspicuous places available to employees and applicants notices to be provided by the City setting out the provisions of the nondiscrimination clauses in this contract.

Article II

The Contractor shall in all solicitations or advertisements for employees placed by or on behalf of the Contractor state that all qualified or qualifiable applicants will be employed without regard to race, religion, color, age, marital status, disability, sex, sexual orientation, gender identity or national origin.

Article III

The Contractor shall send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding a notice to be provided by the City advising the labor union or worker's representative of the Contractor's equal employment opportunity and affirmative action commitments. Such notices shall be posted in conspicuous places available to employees and applicants for employment.

Article V

The Contractor agrees that it will comply with all provisions of the Affirmative Action Ordinance of the City of Madison, including the contract compliance requirements. The Contractor agrees to submit the model affirmative action plan for public works contractors in a form approved by the Affirmative Action Division Manager.

Article VI

The Contractor will maintain records as required by Section 39.02(9)(f) of the Madison General Ordinances and will provide the City Affirmative Action Division with access to such records and to persons who have relevant and necessary information, as provided in Section 39.02(9)(f). The City agrees to keep all such records confidential, except to the extent that public inspection is required by law.

Article VII

In the event of the Contractor's or subcontractor's failure to comply with the Equal Employment Opportunity and Affirmative Action Provisions of this contract or Section 39.03 and 39.02 of the Madison General Ordinances, it is agreed that the City at its option may do any or all of the following:

1. Cancel, terminate or suspend this Contract in whole or in part.
2. Declare the Contractor ineligible for further City contracts until the Affirmative Action requirements are met.

3. Recover on behalf of the City from the prime Contractor 0.5 percent of the contract award price for each week that such party fails or refuses to comply, in the nature of liquidated damages, but not to exceed a total of five percent (5%) of the contract price, or five thousand dollars (\$5,000), whichever is less. Under public works contracts, if a subcontractor is in noncompliance, the City may recover liquidated damages from the prime Contractor in the manner described above. The preceding sentence shall not be construed to prohibit a prime Contractor from recovering the amount of such damage from the non-complying subcontractor.

#### Article VIII

The Contractor shall include the above provisions of this contract in every subcontract so that such provisions will be binding upon each subcontractor. The Contractor shall take such action with respect to any subcontractor as necessary to enforce such provisions, including sanctions provided for noncompliance.

#### Article IX

The Contractor shall allow the maximum feasible opportunity to small business enterprises to compete for any subcontracts entered into pursuant to this contract. (In federally funded contracts the terms "DBE, MBE and WBE" shall be substituted for the term "small business" in this Article.)



**HIGHLAND MANOR STORM SHELTER (BUILDING COMPONENT)  
CONTRACT NO. 7343**

IN WITNESS WHEREOF, the Contractor has hereunto set his/her hand and seal and the City has caused these presents to be sealed with its corporate seal and to be subscribed by its Mayor and City Clerk the day and year first above written.

Countersigned:

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Witness Date

\_\_\_\_\_  
President Date

\_\_\_\_\_  
Witness Date

\_\_\_\_\_  
Secretary Date

CITY OF MADISON, WISCONSIN

Provisions have been made to pay the liability  
that will accrue under this contract.

Approved as to form:

\_\_\_\_\_  
Finance Director

\_\_\_\_\_  
City Attorney

Signed this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_

\_\_\_\_\_  
Witness

\_\_\_\_\_  
Mayor Date

\_\_\_\_\_  
Witness

\_\_\_\_\_  
City Clerk Date

## SECTION I: PAYMENT AND PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that we \_\_\_\_\_  
as \_\_\_\_\_ principal, \_\_\_\_\_ and

Company of \_\_\_\_\_ as surety, are held and firmly bound unto the City of Madison, Wisconsin, in the sum of \_\_\_\_\_ (\$\_\_\_\_\_) Dollars, lawful money of the United States, for the payment of which sum to the City of Madison, we hereby bind ourselves and our respective executors and administrators firmly by these presents.

The condition of this Bond is such that if the above bounden shall on his/her part fully and faithfully perform all of the terms of the Contract entered into between him/herself and the City of Madison for the construction of:

### HIGHLAND MANOR STORM SHELTER (BUILDING COMPONENT) CONTRACT NO. 7343

in Madison, Wisconsin, and shall pay all claims for labor performed and material furnished in the prosecution of said work, and save the City harmless from all claims for damages because of negligence in the prosecution of said work, and shall save harmless the said City from all claims for compensation (under Chapter 102, Wisconsin Statutes) of employees and employees of subcontractor, then this Bond is to be void, otherwise of full force, virtue and effect.

Signed and sealed this \_\_\_\_\_ day of \_\_\_\_\_

Countersigned:

\_\_\_\_\_  
Company Name (Principal)

\_\_\_\_\_  
Witness

\_\_\_\_\_  
President

\_\_\_\_\_  
Seal

\_\_\_\_\_  
Secretary

Approved as to form:

\_\_\_\_\_  
Surety Seal  
☐ Salary Employee ☐ Commission

\_\_\_\_\_  
City Attorney

By \_\_\_\_\_

\_\_\_\_\_  
Attorney-in-Fact

This certifies that I have been duly licensed as an agent for the above company in Wisconsin under License No. \_\_\_\_\_ for the year 20\_\_\_\_\_, and appointed as attorney-in-fact with authority to execute this payment and performance bond which power of attorney has not been revoked.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Agent Signature

## **SECTION J: PREVAILING WAGE RATES**

General Decision Number: WI140005 03/14/2014 WI5

Superseded General Decision Number: WI20130005

State: Wisconsin

Construction Type: Building

County: Dane County in Wisconsin.

BUILDING CONSTRUCTION PROJECTS (does not include residential construction consisting of single family homes and apartments up to and including 4 stories)

| Modification Number | Publication Date |
|---------------------|------------------|
| 0                   | 01/03/2014       |
| 1                   | 02/07/2014       |
| 2                   | 03/14/2014       |

ASBE0205-001 06/01/2001

|   | Rates    | Fringes |
|---|----------|---------|
| Asbestos Removal<br>worker/hazardous material<br>handler  |          |         |
| Includes preparation,<br>wetting, stripping,<br>removal, scrapping,<br>vacuuming, bagging and<br>disposing of all<br>insulation materials from<br>mechanical systems,<br>whether they contain<br>asbestos or not..... | \$ 17.90 | 4.45    |

BOIL0107-001 01/01/2013

|   | Rates    | Fringes |
|---|----------|---------|
| BOILERMAKER                                       |          |         |
| Boilermaker.....                                  | \$ 31.09 | 27.11   |
| Small Boiler Repair (under<br>25,000 lbs/hr)..... | \$ 26.91 | 16.00   |

BRWI0013-001 06/01/2012

|                        | Rates    | Fringes |
|------------------------|----------|---------|
| BRICKLAYER             |          |         |
| Bricklayer.....        | \$ 32.01 | 17.05   |
| Terrazzo Finisher..... | \$ 26.57 | 16.20   |
| Terrazzo Worker.....   | \$ 33.21 | 16.20   |
| Tile Finisher.....     | \$ 23.77 | 16.20   |
| Tile Layer.....        | \$ 29.71 | 16.20   |

CARP0252-007 07/02/2012

| Rates | Fringes |
|-------|---------|
|-------|---------|

CARPENTER (Including  
Acoustical work and Drywall  
hanging; Excluding Batt  
Insulation)

|                        |          |       |
|------------------------|----------|-------|
| CARPENTER & SOFT FLOOR |          |       |
| LAYER.....             | \$ 30.48 | 15.80 |
| MILLWRIGHT.....        | \$ 32.11 | 15.80 |
| PILEDRIVERMAN.....     | \$ 30.98 | 15.80 |

-----  
ELEC0014-005 06/01/2012

|  | Rates | Fringes |
|--|-------|---------|
|--|-------|---------|

Teledata System Installer

|                           |          |       |
|---------------------------|----------|-------|
| Installer/Technician..... | \$ 21.89 | 11.83 |
|---------------------------|----------|-------|

Low voltage construction, installation, maintenance and removal of teledata facilities (voice, data, and video) including outside plant, telephone and data inside wire, interconnect, terminal equipment, central offices, PABX, fiber optic cable and equipment, micro waves, V-SAT, bypass, CATV, WAN (wide area networks), LAN (local area networks), and ISDN (integrated systems digital network).

-----  
ELEC0159-002 06/01/2012

|  | Rates | Fringes |
|--|-------|---------|
|--|-------|---------|

|                  |          |       |
|------------------|----------|-------|
| ELECTRICIAN..... | \$ 32.94 | 18.71 |
|------------------|----------|-------|

-----  
ELEV0132-001 01/01/2014

|  | Rates | Fringes |
|--|-------|---------|
|--|-------|---------|

|                        |          |        |
|------------------------|----------|--------|
| ELEVATOR MECHANIC..... | \$ 46.05 | 26.785 |
|------------------------|----------|--------|

FOOTNOTE:

PAID VACATION: Employer contributes 8% of basic hourly rate as vacation pay for employees with more than 5 years or more of service, and 6% for less than 5 years of service.

PAID HOLIDAYS: New Years Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, Friday after Thanksgiving, and Christmas Day.

-----  
ENGI0139-002 06/02/2013

|  | Rates | Fringes |
|--|-------|---------|
|--|-------|---------|

OPERATOR: Power Equipment

|              |          |       |
|--------------|----------|-------|
| Group 1..... | \$ 35.62 | 18.70 |
| Group 2..... | \$ 34.62 | 18.70 |
| Group 3..... | \$ 33.42 | 18.70 |
| Group 4..... | \$ 32.89 | 18.70 |
| Group 5..... | \$ 30.82 | 18.70 |
| Group 6..... | \$ 30.19 | 18.70 |

HAZARDOUS WASTE PREMIUMS:

EPA Level "A" Protection: \$3.00 per hour  
EPA Level "B" Protection: \$2.00 per hour  
EPA Level "C" Protection: \$1.00 per hour

#### POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Cranes, Tower Cranes and Derricks with or without attachments with a lifting capacity of over 100 tons; Cranes, Tower Cranes, and Derricks with boom, leads and/or jib lengths 176 ft or longer.

GROUP 2: Backhoes (Excavators) weighing 130,000 lbs & over; Cranes, Tower Cranes and Derricks with or without attachments with a lifting capacity of 100 tons or less; Cranes, Tower Cranes, and Derricks with boom, leads, and/or jib lengths 175 ft or less; Caisson Rigs; Pile Driver

GROUP 3: Backhoes (Excavators) weighing under 130,000 lbs; Travelling Crane (bridge type); Milling Machine; Concrete Paver over 27 E; Concrete Spreader and Distributor; Concrete Laser Screed; Concrete Grinder and Planing Machine; Slipform Curb and Gutter Machine; Boring Machine (Directional); Dredge Operator; Skid Rigs; Over 46 meter Concrete Pump.

GROUP 4: Hydraulic Backhoe (tractor or truck mounted); Hydraulic Crane, 10 tons or less; Tractor, Bulldozer, or End Loader (over 40 hp); Motor Patrol; Scraper Operator; Bituminous Plant and Paver Operator; Screed-Milling Machine; Roller over 5 tons; Concrete Pumps 46 meter & under; Grout Pumps; Rotec Type Machine; Hydro Blaster, 10,000 psi and over; Rotary Drill Operator; Percussion Drilling Machine; Air Track Drill with or without integral hammer; Blaster; Boring Machine (vertical or horizontal); Side Boom; Trencher, wheel type or chain type having 8 inch or larger bucket; Rail Leveling Machine (Railroad); Tie Placer; Tie Extractor; Tie Tamper; Stone Leveler; Straddle Carrier; Material Hoists; Stack Hoist; Man Hoists; Mechanic and Welder; Off Road Material Haulers

GROUP 5: Tractor, Bulldozer, or Endloader (under 40 hp); Tampers -Compactors, riding type; Stump Chipper, large; Roller, Rubber Tire; Backfiller; Trencher, chain type (bucket under 8 inch); Concrete Auto Breaker, large; Concrete Finishing Machine (road type); Concrete Batch Hopper; Concrete Conveyor Systems; Concrete Mixers, 14S or over; Pumps, Screw Type and Gypsum); Hydrohammers, small; Brooms and Sweepers; Lift Slab Machine; Roller under 5 tons; Industrial Locomotives; Fireman (Pile Drivers and Derricks); Pumps (well points); Hoists, automatic; A-Frames and Winch Trucks; Hoists (tuggers); Boats (Tug, Safety, Work Barges and Launches); Assistant Engineer

GROUP 6: Shouldering Machine Operator; Farm or Industrial Tractor mounted equipment; Post Hole Digger; Auger (vertical and horizontal); Skid Steer Loader with or without attachments; Robotic Tool Carrier with or without attachments; Power Pack Vibratory/Ultra Sound Driver and Extractor; Fireman (Asphalt Plants); Screed Operator; Stone Crushers and Screening Plants; Air, Electric, Hydraulic

Jacks (Slip Form); Prestress Machines; Air Compressor, 400 CFM or over; Refrigeration Plant/Freeze Machine; Boiler Operators (temporary heat); Forklifts; Welding Machines; Generators; Pumps over 3"; Compressors, under 400 CFM; Heaters, Mechanical; Combination small equipment operator; Winches, small electric; Oiler; Greaser; Rotary Drill Tender; Conveyor; Elevator Operator

-----  
IRON0383-002 06/01/2013

|                 | Rates    | Fringes |
|-----------------|----------|---------|
| IRONWORKER..... | \$ 31.50 | 20.03   |

-----

LABO0464-001 06/03/2013

|   | Rates    | Fringes |
|---|----------|---------|
| Laborer, General.....   | \$ 24.21 | 14.53   |
| Laborer: Asbestos/hazardous material remover<br>(Preparation, removal, and encapsulation of hazardous materials from non-mechanical systems)..... | \$ 24.14 | 13.43   |

-----

PAIN0802-001 06/01/2012

|  | Rates    | Fringes |
|--|----------|---------|
| PAINTER                                  |          |         |
| Brush, Roller.....                       | \$ 24.50 | 16.27   |
| PREMIUM RATES [Add to Basic Hourly Rate] |          |         |
| Swing Work                               | \$0.25   |         |
| Drywall Taper                            | \$0.30   |         |
| Paperhanger                              | \$0.40   |         |
| Steel, Spray                             | \$1.00   |         |

-----

PAIN0941-001 06/01/2013

|              | Rates    | Fringes |
|--------------|----------|---------|
| GLAZIER..... | \$ 38.03 | 13.42   |

-----

\* PLAS0599-001 06/03/2013

|                                   | Rates    | Fringes |
|-----------------------------------|----------|---------|
| CEMENT MASON/CONCRETE FINISHER... | \$ 31.58 | 16.13   |
| PLASTERER.....                    | \$ 32.33 | 18.16   |

-----

PLUM0075-007 01/01/2012

|                                   | Rates    | Fringes |
|-----------------------------------|----------|---------|
| PLUMBER (Including HVAC work).... | \$ 36.72 | 17.97   |

-----

PLUM0601-007 06/01/2013

|                                       | Rates    | Fringes |
|---------------------------------------|----------|---------|
| PIPEFITTER (Including HVAC work)..... | \$ 42.95 | 17.54   |

-----  
SFWI0669-002 07/01/2013

|                       | Rates    | Fringes |
|-----------------------|----------|---------|
| SPRINKLER FITTER..... | \$ 36.79 | 18.46   |

-----  
SHEE0018-009 06/01/2011

|  | Rates    | Fringes |
|--|----------|---------|
| Sheet Metal Worker (Including HVAC Duct work and Technicians)..... | \$ 34.23 | 20.19   |

-----  
TEAM0662-003 05/01/2010

|                      | Rates    | Fringes |
|----------------------|----------|---------|
| TRUCK DRIVER         |          |         |
| 1 & 2 Axles.....     | \$ 25.09 | 15.20   |
| 3 or more Axles..... | \$ 25.24 | 15.20   |

-----  
SUWI2002-011 01/23/2002

|   | Rates    | Fringes |
|---|----------|---------|
| Asbestos Worker/Heat and Frost Insulator..... | \$ 25.36 | 8.37    |
| Laborers:                                     |          |         |
| Concrete Worker.....                          | \$ 16.34 | 3.59    |
| Landscape.....                                | \$ 8.73  | 4.90    |
| ROOFER.....                                   | \$ 18.01 | 3.28    |
| Tile & Marble Finisher.....                   | \$ 13.89 | 7.58    |

-----  
WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

=====

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

-----



The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is union or non-union.

#### Union Identifiers

An identifier enclosed in dotted lines beginning with characters other than "SU" denotes that the union classification and rate have found to be prevailing for that classification. Example: PLUM0198-005 07/01/2011. The first four letters , PLUM, indicate the international union and the four-digit number, 0198, that follows indicates the local union number or district council number where applicable , i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2011, following these characters is the effective date of the most current negotiated rate/collective bargaining agreement which would be July 1, 2011 in the above example.

Union prevailing wage rates will be updated to reflect any changes in the collective bargaining agreements governing the rates.

0000/9999: weighted union wage rates will be published annually each January.

#### Non-Union Identifiers

Classifications listed under an "SU" identifier were derived from survey data by computing average rates and are not union rates; however, the data used in computing these rates may include both union and non-union data. Example: SULA2004-007 5/13/2010. SU indicates the rates are not union majority rates, LA indicates the State of Louisiana; 2004 is the year of the survey; and 007 is an internal number used in producing the wage determination. A 1993 or later date, 5/13/2010, indicates the classifications and rates under that identifier were issued as a General Wage Determination on that date.

Survey wage rates will remain in effect and will not change until a new survey is conducted.

---

#### WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- \* an existing published wage determination
- \* a survey underlying a wage determination
- \* a Wage and Hour Division letter setting forth a position on

- a wage determination matter
- \* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations  
Wage and Hour Division  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

=====

END OF GENERAL DECISION

## PREVAILING WAGE RATE DETERMINATION

Issued by the State of Wisconsin  
Department of Workforce Development  
Pursuant to s. 66.0903, Wis. Stats.  
Issued On: 01/06/2014  
Amended On: 02/28/2014

**DETERMINATION NUMBER:** 201400001

**EXPIRATION DATE:** Prime Contracts MUST Be Awarded or Negotiated On Or Before 12/31/2014. If NOT, You MUST Reapply.

**PROJECT NAME:** ALL PUBLIC WORKS PROJECTS UNDER SEC 66.0903, STATS - CITY OF MADISON

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

**CONTRACTING AGENCY:** CITY OF MADISON-ENGINEERING

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

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

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

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

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

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

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

**s. 66.0903 (11) LIABILITY AND PENALTIES.**

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

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

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

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

|                                       |
|---------------------------------------|
| <b>BUILDING OR HEAVY CONSTRUCTION</b> |
|---------------------------------------|

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

|                       |
|-----------------------|
| <b>SKILLED TRADES</b> |
|-----------------------|

| Fringe Benefits Must Be Paid On <u>All</u> Hours Worked |  | HOURLY<br>BASIC RATE<br>OF PAY | HOURLY<br>FRINGE<br>BENEFITS | TOTAL |
|---|--|--------------------------------|------------------------------|-------|
| <u>CODE</u>   | <u>TRADE OR OCCUPATION</u>   | \$                             | \$                           | \$    |
| 101   | Acoustic Ceiling Tile Installer  | 30.48                          | 15.90                        | 46.38 |
| 102   | Boilermaker<br>Future Increase(s):<br>Add \$1.50/hr on 1/01/2015; Add \$1.50/hr. on<br>01/01/2016  | 32.05                          | 28.04                        | 60.09 |
| 103   | Bricklayer, Blocklayer or Stonemason<br>Premium Increase(s):<br>DOT PREMIUM: Pay two times the hourly basic rate on<br>Sunday, New Year's Day, Memorial Day, Independence<br>Day, Labor Day, Thanksgiving Day & Christmas Day. | 32.01                          | 17.35                        | 49.36 |
| 104   | Cabinet Installer  | 30.48                          | 15.90                        | 46.38 |
| 105   | Carpenter  | 30.48                          | 15.90                        | 46.38 |
| 106   | Carpet Layer or Soft Floor Coverer   | 30.48                          | 15.90                        | 46.38 |
| 107   | Cement Finisher  | 31.58                          | 16.13                        | 47.71 |
| 108   | Drywall Taper or Finisher  | 24.80                          | 16.60                        | 41.40 |
| 109   | Electrician<br>Premium Increase(s):<br>DOT PREMIUM: Pay two times the hourly basic rate on<br>Sunday, New Year's Day, Memorial Day, Independence<br>Day, Labor Day, Thanksgiving Day & Christmas Day.                          | 34.07                          | 19.25                        | 53.32 |
| 110   | Elevator Constructor   | 42.86                          | 23.84                        | 66.70 |
| 111   | Fence Erector  | 24.72                          | 0.00                         | 24.72 |
| 112   | Fire Sprinkler Fitter  | 36.07                          | 18.73                        | 54.80 |
| 113   | Glazier  | 38.03                          | 13.42                        | 51.45 |
| 114   | Heat or Frost Insulator  | 33.68                          | 24.31                        | 57.99 |
| 115   | Insulator (Batt or Blown)  | 15.00                          | 9.50                         | 24.50 |
| 116   | Ironworker   | 31.25                          | 19.46                        | 50.71 |
| 117   | Lather   | 30.48                          | 15.90                        | 46.38 |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>   | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 118  | Line Constructor (Electrical)  | 38.25                                   | 17.31                                 | 55.56        |
| 119  | Marble Finisher  | 26.89                                   | 19.18                                 | 46.07        |
| 120  | Marble Mason   | 32.01                                   | 17.35                                 | 49.36        |
| 121  | Metal Building Erector   | 22.00                                   | 10.00                                 | 32.00        |
| 122  | Millwright   | 32.11                                   | 15.95                                 | 48.06        |
| 123  | Overhead Door Installer  | 20.95                                   | 4.94                                  | 25.89        |
| 124  | Painter  | 24.50                                   | 16.60                                 | 41.10        |
| 125  | Pavement Marking Operator  | 30.00                                   | 0.00                                  | 30.00        |
| 126  | Piledriver   | 30.98                                   | 15.90                                 | 46.88        |
| 127  | Pipeline Fuser or Welder (Gas or Utility)  | 30.79                                   | 19.74                                 | 50.53        |
| 129  | Plasterer  | 31.03                                   | 17.71                                 | 48.74        |
| 130  | Plumber<br>Future Increase(s):<br>Add \$1/hr on 6/1/2014.  | 36.42                                   | 16.87                                 | 53.29        |
| 132  | Refrigeration Mechanic   | 41.60                                   | 16.71                                 | 58.31        |
| 133  | Roofer or Waterproofor   | 29.40                                   | 6.25                                  | 35.65        |
| 134  | Sheet Metal Worker   | 34.45                                   | 22.57                                 | 57.02        |
| 135  | Steamfitter<br>Future Increase(s):<br>Add \$1.70/hr on 6/1/2014.   | 42.95                                   | 17.81                                 | 60.76        |
| 137  | Teledata Technician or Installer<br>Premium Increase(s):<br>DOT PREMIUM: Pay two times the hourly basic rate on<br>Sunday, New Year's Day, Memorial Day, Independence<br>Day, Labor Day, Thanksgiving Day & Christmas Day. | 22.25                                   | 12.24                                 | 34.49        |
| 138  | Temperature Control Installer  | 32.94                                   | 18.80                                 | 51.74        |
| 139  | Terrazzo Finisher  | 26.89                                   | 19.18                                 | 46.07        |
| 140  | Terrazzo Mechanic  | 30.20                                   | 18.42                                 | 48.62        |
| 141  | Tile Finisher  | 23.85                                   | 17.18                                 | 41.03        |
| 142  | Tile Setter  | 29.81                                   | 17.18                                 | 46.99        |
| 143  | Tuckpointer, Caulker or Cleaner  | 35.25                                   | 13.15                                 | 48.40        |
| 144  | Underwater Diver (Except on Great Lakes)   | 34.48                                   | 15.90                                 | 50.38        |
| 146  | Well Driller or Pump Installer   | 25.32                                   | 15.65                                 | 40.97        |
| 147  | Siding Installer   | 25.92                                   | 18.04                                 | 43.96        |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  |  |  |                     |
|--|--|--|--|---------------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>                            | <b><u>HOURLY<br/>BASIC RATE<br/>OF PAY</u></b> | <b><u>HOURLY<br/>FRINGE<br/>BENEFITS</u></b> | <b><u>TOTAL</u></b> |
|  |  | <b>\$</b>                                      | <b>\$</b>                                    | <b>\$</b>           |
| 150  | Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY | 29.16  | 14.34  | 43.50               |
| 151  | Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY  | 30.60  | 14.86  | 45.46               |
| 152  | Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY       | 26.78  | 13.63  | 40.41               |
| 153  | Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY       | 24.86  | 12.97  | 37.83               |
| 154  | Groundman - ELECTRICAL LINE CONSTRUCTION ONLY                | 21.75  | 12.70  | 34.45               |

**TRUCK DRIVERS**

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  |  |  |                     |
|--|--|--|--|---------------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>                      | <b><u>HOURLY<br/>BASIC RATE<br/>OF PAY</u></b> | <b><u>HOURLY<br/>FRINGE<br/>BENEFITS</u></b> | <b><u>TOTAL</u></b> |
|  |  | <b>\$</b>                                      | <b>\$</b>                                    | <b>\$</b>           |
| 201  | Single Axle or Two Axle                                | 32.39  | 18.46  | 50.85               |
| 203  | Three or More Axle                                     | 18.00  | 22.88  | 40.88               |
| 204  | Articulated, Euclid, Dumptor, Off Road Material Hauler | 32.89  | 18.96  | 51.85               |
| 205  | Pavement Marking Vehicle                               | 18.00  | 22.88  | 40.88               |
| 207  | Truck Mechanic   | 18.00  | 22.88  | 40.88               |

**LABORERS**

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |   |  |  |                     |
|--|---|--|--|---------------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>   | <b><u>HOURLY<br/>BASIC RATE<br/>OF PAY</u></b> | <b><u>HOURLY<br/>FRINGE<br/>BENEFITS</u></b> | <b><u>TOTAL</u></b> |
|  |   | <b>\$</b>                                      | <b>\$</b>                                    | <b>\$</b>           |
| 301  | General Laborer<br>Premium Increase(s):<br>Add \$1.00/hr for certified welder; Add \$.25/hr for mason tender  | 24.21  | 14.63  | 38.84               |
| 302  | Asbestos Abatement Worker   | 24.36  | 14.44  | 38.80               |
| 303  | Landscaper  | 21.01  | 9.37   | 30.38               |
| 310  | Gas or Utility Pipeline Laborer (Other Than Sewer and Water)  | 21.01  | 13.63  | 34.64               |
| 311  | Fiber Optic Laborer (Outside, Other Than Concrete Encased)<br>Premium Increase(s):<br>DOT PREMIUMS: Pay two times the hourly basic rate on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. | 18.33  | 13.65  | 31.98               |
| 314  | Railroad Track Laborer  | 23.46  | 3.30   | 26.76               |
| 315  | Final Construction Clean-Up Worker  | 16.00  | 0.00   | 16.00               |

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

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>   | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 501  | Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Milling Machine; Boring Machine (Directional, Horizontal or Vertical); Backhoe (Track Type) Having a Mfg'r's Rated Capacity of 130,000 Lbs. or Over; Backhoe (Track Type) Having a Mfg'r's Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Crane, Shovel, Dragline, Clamshells; Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Grader or Motor Patrol; Master Mechanic; Mechanic or Welder; Robotic Tool Carrier (With or Without Attachments); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Tractor (Scraper, Dozer, Pusher, Loader); Trencher (Wheel Type or Chain Type Having Over 8 Inch Bucket). | 33.42                                   | 18.96                                 | 52.38        |
| 502  | Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Environmental Burner; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Jeep Digger; Screed (Milling Machine); Skid Rig; Straddle Carrier or Travel Lift; Stump Chipper; Trencher (Wheel Type or Chain Type Having 8 Inch Bucket & Under).   | 32.89                                   | 18.96                                 | 51.85        |
| 503  | Air Compressor (&/or 400 CFM or Over); Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Greaser; High Pressure Utility Locating Machine (Daylighting Machine); Mulcher; Oiler; Post Hole Digger or Driver; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack.  | 30.82                                   | 18.96                                 | 49.78        |
| 504  | Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.  | 38.80                                   | 20.17                                 | 58.97        |
| 505  | Work Performed on the Great Lakes Including Crane or Backhoe Operator; Assistant Hydraulic Dredge Engineer; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder; 70 Ton & Over Tug Operator.<br>Premium Increase(s):<br>Add \$.50/hr for Friction Crane, Lattice Boom or Crane Certification (CCO).  | 41.65                                   | 21.71                                 | 63.36        |
| 506  | Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.  | 37.10                                   | 21.57                                 | 58.67        |



|     |   |       |       |       |
|-----|---|-------|-------|-------|
| 507 | Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY. | 34.50 | 20.04 | 54.54 |
|-----|---|-------|-------|-------|

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

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |   | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|---|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>  | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 508  | Boring Machine (Directional); Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic.<br>Premium Increase(s):<br>Add \$.50/hr for >200 Ton / Add \$1/hr at 300 Ton / Add \$1.50/hr at 400 Ton / Add \$2/hr at 500 Ton & Over.  | 35.62                                   | 18.96                                 | 54.58        |
| 509  | Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Boring Machine (Horizontal or Vertical); Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Pile Driver; Versi Lifts, Tri-Lifts & Gantrys (20,000 Lbs. & Over).   | 36.35                                   | 6.95                                  | 43.30        |
| 510  | Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Dredge (NOT Performing Work on the Great Lakes); Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Hydro-Blaster (10,000 PSI or Over); Milling Machine; Skid Rig; Traveling Crane (Bridge Type).   | 33.42                                   | 18.96                                 | 52.38        |
| 511  | Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Environmental Burner; Gantrys (Under 20,000 Lbs.); Grader or Motor Patrol; High Pressure Utility Locating Machine (Daylighting Machine); Manhoist; Material or Stack Hoist; Mechanic or Welder; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tining or Curing Machine; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). | 32.89                                   | 18.96                                 | 51.85        |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |   | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|---|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>  | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 512  | Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Grout Pump; Hoist (Tugger, Automatic); Industrial Locomotives; Jeep Digger; Lift Slab Machine; Mulcher; Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames. | 30.82                                   | 18.96                                 | 49.78        |
| 513  | Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Boatmen (NOT Performing Work on the Great Lakes); Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Elevator; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Forklift; Generator (&/or 150 KW or Over); Greaser; Heaters (Mechanical); Loading Machine (Conveyor); Oiler; Post Hole Digger or Driver; Prestress Machine; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Robotic Tool Carrier (With or Without Attachments); Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack.               | 24.19                                   | 17.89                                 | 42.08        |
| 514  | Gas or Utility Pipeline, Except Sewer & Water (Primary Equipment).  | 36.34                                   | 21.14                                 | 57.48        |
| 515  | Gas or Utility Pipeline, Except Sewer & Water (Secondary Equipment).<br>Future Increase(s):<br>Add \$1.60/hr on 06/01/2014; Add \$1.65/hr on 06/01/2015.  | 32.32                                   | 18.55                                 | 50.87        |
| 516  | Fiber Optic Cable Equipment<br>Future Increase(s):<br>Add \$1.75/hr on 02/01/2014.  | 27.89                                   | 17.20                                 | 45.09        |

**SEWER, WATER OR TUNNEL CONSTRUCTION**

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

**SKILLED TRADES**

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |   | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|---|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>  | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 103  | Bricklayer, Blocklayer or Stonemason<br>Premium Increase(s):<br>DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.  | 35.10                                   | 18.40                                 | 53.50        |
| 105  | Carpenter<br>Future Increase(s):<br>Add \$1.25/hr on 6/2/2014.<br>Premium Increase(s):<br>DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.  | 33.68                                   | 19.81                                 | 53.49        |
| 107  | Cement Finisher<br>Future Increase(s):<br>Add \$1.87 on 6/1/14; Add \$1.87 on 6/1/15; Add \$1.75 on 6/1/16.<br>Premium Increase(s):<br>DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise. | 33.51                                   | 16.13                                 | 49.64        |
| 109  | Electrician<br>Premium Increase(s):<br>DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.   | 32.82                                   | 22.61                                 | 55.43        |
| 111  | Fence Erector   | 24.72                                   | 0.00                                  | 24.72        |
| 116  | Ironworker  | 31.25                                   | 19.46                                 | 50.71        |
| 118  | Line Constructor (Electrical)   | 38.25                                   | 17.31                                 | 55.56        |
| 125  | Pavement Marking Operator   | 16.00                                   | 7.35                                  | 23.35        |
| 126  | Piledriver  | 30.98                                   | 15.90                                 | 46.88        |
| 130  | Plumber   | 33.75                                   | 14.07                                 | 47.82        |
| 135  | Steamfitter   | 42.45                                   | 16.71                                 | 59.16        |
| 137  | Teledata Technician or Installer  | 21.89                                   | 11.85                                 | 33.74        |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>                            | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 143  | Tuckpointer, Caulker or Cleaner                              | 35.25                                   | 13.15                                 | 48.40        |
| 144  | Underwater Diver (Except on Great Lakes)                     | 38.80                                   | 20.17                                 | 58.97        |
| 146  | Well Driller or Pump Installer                               | 25.32                                   | 15.65                                 | 40.97        |
| 150  | Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY | 29.16                                   | 14.34                                 | 43.50        |
| 151  | Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY  | 30.60                                   | 14.86                                 | 45.46        |
| 152  | Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY       | 26.78                                   | 13.63                                 | 40.41        |
| 153  | Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY       | 24.86                                   | 12.97                                 | 37.83        |
| 154  | Groundman - ELECTRICAL LINE CONSTRUCTION ONLY                | 21.75                                   | 12.70                                 | 34.45        |

**TRUCK DRIVERS**

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |   | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|---|---|---------------------------------------|--------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>                     | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 201  | Single Axle or Two Axle                               | 30.00                                   | 15.00                                 | 45.00        |
| 203  | Three or More Axle                                    | 16.00                                   | 7.35                                  | 23.35        |
| 204  | Articulated, Euclid, Dumptr, Off Road Material Hauler | 32.89                                   | 18.96                                 | 51.85        |
| 205  | Pavement Marking Vehicle                              | 16.00                                   | 7.35                                  | 23.35        |
| 207  | Truck Mechanic  | 16.00                                   | 7.35                                  | 23.35        |

**LABORERS**

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>  | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 301  | General Laborer<br>Premium Increase(s):<br>Add \$.20 for blaster, bracer, manhole builder, caulker,<br>bottomman and power tool; Add \$.55 for pipelayer; Add<br>\$1.00 for tunnel work 0-15 lbs. compressed air; Add<br>\$2.00 for over 15-30 lbs. compressed air; Add \$3.00 for<br>over 30 lbs. compressed air. | 25.60                                   | 14.62                                 | 40.22        |
| 303  | Landscaper   | 25.28                                   | 11.46                                 | 36.74        |
| 304  | Flagperson or Traffic Control Person   | 24.70                                   | 10.72                                 | 35.42        |
| 311  | Fiber Optic Laborer (Outside, Other Than Concrete Encased)   | 18.31                                   | 12.67                                 | 30.98        |
| 314  | Railroad Track Laborer   | 23.46                                   | 3.30                                  | 26.76        |

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

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |   | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|---|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>  | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 521  | Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Master Mechanic; Pile Driver.<br>Premium Increase(s):<br>Add \$.25/hr for all >45 Ton lifting capacity cranes  | 34.62                                   | 18.96                                 | 53.58        |
| 522  | Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Spreader & Distributor; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Dredge (NOT Performing Work on the Great Lakes); Milling Machine; Skid Rig; Telehandler; Traveling Crane (Bridge Type).  | 33.42                                   | 18.96                                 | 52.38        |
| 523  | Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Boring Machine (Horizontal or Vertical); Bulldozer or Endloader (Over 40 hp); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Manhoist; Material or Stack Hoist; Mechanic or Welder; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). | 32.89                                   | 18.96                                 | 51.85        |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>   | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 524  | Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Environmental Burner; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Hoist (Tugger, Automatic); Grout Pump; Jeep Digger; Lift Slab Machine; Mulcher; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Tining or Curing Machine; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames.<br>Future Increase(s):<br>Add \$1.05/hr on 6/2/2014; Add \$1.55/hr on 6/1/2015.<br>Premium Increase(s):<br>Add \$.25/hr for operating tower crane. | 35.11                                   | 19.45                                 | 54.56        |
| 525  | Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Loading Machine (Conveyor); Post Hole Digger or Driver; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack.  | 30.19                                   | 20.94                                 | 51.13        |
| 526  | Boiler (Temporary Heat); Forklift; Greaser; Oiler.   | 24.19                                   | 17.89                                 | 42.08        |
| 527  | Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.  | 38.80                                   | 20.17                                 | 58.97        |
| 528  | Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.   | 38.80                                   | 20.17                                 | 58.97        |
| 529  | Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.  | 34.50                                   | 20.04                                 | 54.54        |
| 530  | Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under), Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.  | 34.50                                   | 20.04                                 | 54.54        |

|   |
|---|
| <b>AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION</b> |
|---|

**Includes all airport projects (excluding buildings) and all projects awarded by the Wisconsin Department of Transportation (excluding buildings).**

|                       |
|-----------------------|
| <b>SKILLED TRADES</b> |
|-----------------------|

| Fringe Benefits Must Be Paid On <u>All</u> Hours Worked |   |   |   |                    |
|---|---|---|---|--------------------|
| <u>CODE</u>   | <u>TRADE OR OCCUPATION</u>  | <u>HOURLY<br/>BASIC RATE<br/>OF PAY</u><br>\$ | <u>HOURLY<br/>FRINGE<br/>BENEFITS</u><br>\$ | <u>TOTAL</u><br>\$ |
| 103   | Bricklayer, Blocklayer or Stonemason  | 32.01   | 17.35                                       | 49.36              |
| 105   | Carpenter   | 30.48   | 15.90                                       | 46.38              |
| 107   | Cement Finisher<br>Future Increase(s):<br>Add \$1.87 on 6/1/14; Add \$1.87 on 6/1/15; Add \$1.75 on 6/1/16.<br>Premium Increase(s):<br>DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise. | 33.51   | 16.13                                       | 49.64              |
| 109   | Electrician<br>Premium Increase(s):<br>DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.   | 34.07   | 19.25                                       | 53.32              |
| 111   | Fence Erector   | 24.72   | 0.00  | 24.72              |
| 116   | Ironworker  | 31.25   | 19.46                                       | 50.71              |
| 118   | Line Constructor (Electrical)   | 38.25   | 17.31                                       | 55.56              |
| 124   | Painter   | 21.87   | 11.37                                       | 33.24              |
| 125   | Pavement Marking Operator   | 30.00   | 0.00  | 30.00              |
| 126   | Piledriver  | 30.98   | 15.90                                       | 46.88              |
| 133   | Roofer or Waterproofer  | 29.40   | 6.25  | 35.65              |
| 137   | Teledata Technician or Installer  | 21.89   | 11.85                                       | 33.74              |
| 143   | Tuckpointer, Caulker or Cleaner   | 35.25   | 13.15                                       | 48.40              |
| 144   | Underwater Diver (Except on Great Lakes)  | 34.48   | 15.90                                       | 50.38              |
| 150   | Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY  | 34.43   | 15.24                                       | 49.67              |
| 151   | Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY   | 35.50   | 15.89                                       | 51.39              |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>                      | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 152  | Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY | 26.78                                   | 13.63                                 | 40.41        |
| 153  | Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY | 24.86                                   | 12.97                                 | 37.83        |
| 154  | Groundman - ELECTRICAL LINE CONSTRUCTION ONLY          | 21.75                                   | 12.70                                 | 34.45        |
| <b>TRUCK DRIVERS</b>   |  |   |                                       |              |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |   | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|---|---|---------------------------------------|--------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>   | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 201  | Single Axle or Two Axle   | 34.22                                   | 19.90                                 | 54.12        |
| 203  | Three or More Axle<br>Future Increase(s):<br>Add \$1.30/hr on 6/1/2014.<br>Premium Increase(s):<br>DOT PREMIUM: Pay two times the hourly basic rate on<br>Sunday, New Year's Day, Memorial Day, Independence<br>Day, Labor Day, Thanksgiving Day & Christmas Day.   | 24.52                                   | 17.77                                 | 42.29        |
| 204  | Articulated, Euclid, Dumptor, Off Road Material Hauler<br>Future Increase(s):<br>Add \$1.75/hr on 6/1/14); Add \$1.25/hr on 6/1/15); Add<br>\$1.30/hr on 6/1/16); Add \$1.25/hr on 6/1/17.<br>Premium Increase(s):<br>DOT PREMIUMS: 1) Pay two times the hourly basic<br>rate on Sunday, New Year's Day, Memorial Day,<br>Independence Day, Labor Day, Thanksgiving Day &<br>Christmas Day. 2) Add \$1.50/hr night work premium.<br>See DOT'S website for details about the applicability of<br>this night work premium at: <a href="http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm">http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm</a> . | 29.27                                   | 20.40                                 | 49.67        |
| 205  | Pavement Marking Vehicle  | 23.31                                   | 17.13                                 | 40.44        |
| 206  | Shadow or Pilot Vehicle   | 34.22                                   | 19.90                                 | 54.12        |
| 207  | Truck Mechanic  | 23.31                                   | 17.13                                 | 40.44        |



**LABORERS**

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>   | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 301  | General Laborer<br>Future Increase(s):<br>Add \$1.60/hr on 6/1/2014.<br>Premium Increase(s):<br>Add \$.10/hr for topman, air tool operator, vibrator or<br>tamper operator (mechanical hand operated), chain saw<br>operator and demolition burning torch laborer; Add<br>\$.15/hr for bituminous worker (raker and luteman),<br>formsetter (curb, sidewalk and pavement) and strike off<br>man; Add \$.20/hr for blaster and powderman; Add<br>\$.25/hr for bottomman; Add \$.35/hr for line and grade<br>specialist; Add \$.45/hr for pipelayer. / DOT PREMIUMS:<br>1) Pay two times the hourly basic rate on Sunday, New<br>Year's Day, Memorial Day, Independence Day, Labor<br>Day, Thanksgiving Day & Christmas Day. 2) Add<br>\$1.25/hr for work on projects involving temporary traffic<br>control setup, for lane and shoulder closures, when<br>work under artificial illumination conditions is necessary<br>as required by the project provisions (including prep<br>time prior to and/or cleanup after such time period). | 29.32                                   | 14.63                                 | 43.95        |
| 302  | Asbestos Abatement Worker  | 24.36                                   | 14.44                                 | 38.80        |
| 303  | Landscaper<br>Future Increase(s):<br>Add \$1.60/hr on 6/1/14.<br>Premium Increase(s):<br>DOT PREMIUMS: 1) Pay two times the hourly basic<br>rate on Sunday, New Year's Day, Memorial Day,<br>Independence Day, Labor Day, Thanksgiving Day &<br>Christmas Day. 2) Add \$1.25/hr for work on projects<br>involving temporary traffic control setup, for lane and<br>shoulder closures, when work under artificial illumination<br>conditions is necessary as required by the project<br>provisions (including prep time prior to and/or cleanup<br>after such time period).   | 29.32                                   | 14.63                                 | 43.95        |
| 304  | Flagperson or Traffic Control Person<br>Future Increase(s):<br>Add \$1.60/hr on 6/1/2014.<br>Premium Increase(s):<br>DOT PREMIUMS: 1) Pay two times the hourly basic<br>rate on Sunday, New Year's Day, Memorial Day,<br>Independence Day, Labor Day, Thanksgiving Day &<br>Christmas Day. 2) Add \$1.25/hr when the Wisconsin<br>Department of Transportation or responsible governing<br>agency requires that work be performed at night under<br>artificial illumination with traffic control and the work is<br>completed after sunset and before sunrise.   | 25.67                                   | 14.63                                 | 40.30        |
| 311  | Fiber Optic Laborer (Outside, Other Than Concrete Encased)   | 18.31                                   | 12.67                                 | 30.98        |
| 314  | Railroad Track Laborer   | 23.46                                   | 3.30                                  | 26.76        |

**HEAVY EQUIPMENT OPERATORS  
AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION**

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |   | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|---|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>  | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 531  | Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Traveling Crane (Bridge Type).<br>Future Increase(s):<br>Add \$1.75/hr on 6/1/2014); Add \$1.25/hr on 6/1/2015);<br>Add \$1.30/hr on 6/1/2016); Add \$1.25/hr on 6/1/2017.<br>Premium Increase(s):<br>DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium.<br>See DOT'S website for details about the applicability of this night work premium at: <a href="http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm">http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm</a> .   | 36.72                                   | 20.40                                 | 57.12        |
| 532  | Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs., & Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver.<br>Future Increase(s):<br>Add \$1.75/hr on 6/1/2014); Add \$1.25/hr on 6/1/2015);<br>Add \$1.30/hr on 6/1/2016); Add \$1.25/hr on 6/1/2017.<br>Premium Increase(s):<br>DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium.<br>See DOT'S website for details about the applicability of this night work premium at: <a href="http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm">http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm</a> . | 36.22                                   | 20.40                                 | 56.62        |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>  | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 533  | <p>Air Track, Rotary or Percussion Drilling Machine &amp;/or Hammers, Blaster; Asphalt Heater, Planer &amp; Scarifier; Asphalt Milling Machine; Asphalt Screed; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. &amp; Under); Bituminous (Asphalt) Plant &amp; Paver, Screed; Boatmen (NOT Performing Work on the Great Lakes); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb &amp; Gutter Machine; Concrete Spreader &amp; Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches &amp; A-Frames.</p> <p>Future Increase(s):<br/>           Add \$1.75/hr on 6/1/2014); Add \$1.25/hr on 6/1/2015);<br/>           Add \$1.30/hr on 6/1/2016); Add \$1.25/hr on 6/1/2017.</p> <p>Premium Increase(s):<br/>           DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day &amp; Christmas Day. 2) Add \$1.50/hr night work premium.<br/>           See DOT'S website for details about the applicability of this night work premium at: <a href="http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm">http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm</a>.</p> | 35.72                                   | 20.40                                 | 56.12        |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |   | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|---|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>  | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 534  | <p>Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed &amp; Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver &amp; Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine.</p> <p>Future Increase(s):<br/>           Add \$1.75/hr on 6/1/2014); Add \$1.25/hr on 6/1/2015);<br/>           Add \$1.30/hr on 6/1/2016); Add \$1.25/hr on 6/1/2017.</p> <p>Premium Increase(s):<br/>           DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day &amp; Christmas Day. 2) Add \$1.50/hr night work premium.<br/>           See DOT'S website for details about the applicability of this night work premium at: <a href="http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm">http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm</a>.</p> | 35.46                                   | 20.40                                 | 55.86        |
| 535  | <p>Air Compressor (&amp;/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical &amp; Horizontal); Automatic Belt Conveyor &amp; Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&amp;/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack.</p> <p>Future Increase(s):<br/>           Add \$1.75/hr on 6/1/2014); Add \$1.25/hr on 6/1/2015);<br/>           Add \$1.30/hr on 6/1/2016); Add \$1.25/hr on 6/1/2017.</p> <p>Premium Increase(s):<br/>           DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day &amp; Christmas Day. 2) Add \$1.50/hr night work premium.<br/>           See DOT'S website for details about the applicability of this night work premium at: <a href="http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm">http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm</a>.</p>   | 35.17                                   | 20.40                                 | 55.57        |
| 536  | Fiber Optic Cable Equipment.  | 26.69                                   | 16.65                                 | 43.34        |
| 537  | Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.   | 38.80                                   | 20.17                                 | 58.97        |
| 538  | Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.  | 38.80                                   | 20.17                                 | 58.97        |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |   |  |  |                     |
|--|---|--|--|---------------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>   | <b><u>HOURLY<br/>BASIC RATE<br/>OF PAY</u></b> | <b><u>HOURLY<br/>FRINGE<br/>BENEFITS</u></b> | <b><u>TOTAL</u></b> |
|  |   | <b>\$</b>                                      | <b>\$</b>                                    | <b>\$</b>           |
| 539  | Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.   | 34.50  | 20.04  | 54.54               |
| 540  | Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks-Great Lakes ONLY. | 34.50  | 20.04  | 54.54               |

|  |
|--|
| <b>LOCAL STREET OR MISCELLANEOUS PAVING CONSTRUCTION</b> |
|--|

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

|                       |
|-----------------------|
| <b>SKILLED TRADES</b> |
|-----------------------|

| Fringe Benefits Must Be Paid On <u>All</u> Hours Worked |  |   |                                       |              |
|---|--|---|---------------------------------------|--------------|
| <u>CODE</u>   | <u>TRADE OR OCCUPATION</u>                                   | <u>HOURLY<br/>BASIC RATE<br/>OF PAY</u> | <u>HOURLY<br/>FRINGE<br/>BENEFITS</u> | <u>TOTAL</u> |
|   |  | \$                                      | \$                                    | \$           |
| 103   | Bricklayer, Blocklayer or Stonemason                         | 32.01                                   | 17.35                                 | 49.36        |
| 105   | Carpenter  | 32.93                                   | 19.93                                 | 52.86        |
| 107   | Cement Finisher  | 31.48                                   | 15.68                                 | 47.16        |
| 109   | Electrician  | 31.27                                   | 22.81                                 | 54.08        |
| 111   | Fence Erector  | 24.72                                   | 0.00                                  | 24.72        |
| 116   | Ironworker   | 31.25                                   | 19.46                                 | 50.71        |
| 118   | Line Constructor (Electrical)                                | 38.25                                   | 17.31                                 | 55.56        |
| 124   | Painter  | 24.50                                   | 16.60                                 | 41.10        |
| 125   | Pavement Marking Operator                                    | 30.00                                   | 0.00                                  | 30.00        |
| 126   | Piledriver   | 30.98                                   | 15.90                                 | 46.88        |
| 133   | Roofer or Waterproofer                                       | 29.40                                   | 6.25                                  | 35.65        |
| 137   | Teledata Technician or Installer                             | 21.89                                   | 11.85                                 | 33.74        |
| 143   | Tuckpointer, Caulker or Cleaner                              | 35.25                                   | 13.15                                 | 48.40        |
| 144   | Underwater Diver (Except on Great Lakes)                     | 38.80                                   | 20.17                                 | 58.97        |
| 150   | Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY | 34.43                                   | 15.24                                 | 49.67        |
| 151   | Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY  | 30.60                                   | 14.86                                 | 45.46        |
| 152   | Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY       | 26.78                                   | 13.63                                 | 40.41        |
| 153   | Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY       | 24.86                                   | 12.97                                 | 37.83        |
| 154   | Groundman - ELECTRICAL LINE CONSTRUCTION ONLY                | 21.75                                   | 12.70                                 | 34.45        |

|                      |
|----------------------|
| <b>TRUCK DRIVERS</b> |
|----------------------|

| Fringe Benefits Must Be Paid On <u>All</u> Hours Worked |                            |   |                                       |              |
|---|----------------------------|---|---------------------------------------|--------------|
| <u>CODE</u>   | <u>TRADE OR OCCUPATION</u> | <u>HOURLY<br/>BASIC RATE<br/>OF PAY</u> | <u>HOURLY<br/>FRINGE<br/>BENEFITS</u> | <u>TOTAL</u> |
|   |                            | \$                                      | \$                                    | \$           |
| 201   | Single Axle or Two Axle    | 30.00                                   | 15.00                                 | 45.00        |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>                      | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 203  | Three or More Axle                                     | 17.00                                   | 0.00                                  | 17.00        |
| 204  | Articulated, Euclid, Dumptor, Off Road Material Hauler | 32.89                                   | 18.96                                 | 51.85        |
| 205  | Pavement Marking Vehicle                               | 17.00                                   | 0.00                                  | 17.00        |
| 206  | Shadow or Pilot Vehicle                                | 30.00                                   | 15.00                                 | 45.00        |
| 207  | Truck Mechanic   | 17.00                                   | 0.00                                  | 17.00        |

**LABORERS**

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>  | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 301  | General Laborer  | 28.07                                   | 13.25                                 | 41.32        |
| 303  | Landscaper<br>Future Increase(s):<br>Add \$1.60/hr on 6/1/14.<br>Premium Increase(s):<br>DOT PREMIUMS: 1) Pay two times the hourly basic<br>rate on Sunday, New Year's Day, Memorial Day,<br>Independence Day, Labor Day, Thanksgiving Day &<br>Christmas Day. 2) Add \$1.25/hr for work on projects<br>involving temporary traffic control setup, for lane and<br>shoulder closures, when work under artificial illumination<br>conditions is necessary as required by the project<br>provisions (including prep time prior to and/or cleanup<br>after such time period). | 29.04                                   | 14.63                                 | 43.67        |
| 304  | Flagperson or Traffic Control Person   | 24.70                                   | 10.72                                 | 35.42        |
| 311  | Fiber Optic Laborer (Outside, Other Than Concrete Encased)   | 18.31                                   | 12.67                                 | 30.98        |
| 314  | Railroad Track Laborer   | 23.46                                   | 3.30                                  | 26.76        |

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

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>   | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 541  | Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic.<br>Future Increase(s):<br>Add \$1.75/hr on 6/1/2014); Add \$1.25/hr on 6/1/2015);<br>Add \$1.30/hr on 6/1/2016); Add \$1.25/hr on 6/1/2017.<br>Premium Increase(s):<br>DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: <a href="http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm">http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm</a> .   | 36.72                                   | 20.40                                 | 57.12        |
| 542  | Backhoe (Track Type) Having a Mfrg.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Crane, Tower Crane Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver.<br>Future Increase(s):<br>Add \$1.75/hr on 6/1/2014); Add \$1.25/hr on 6/1/2015);<br>Add \$1.30/hr on 6/1/2016); Add \$1.25/hr on 6/1/2017.<br>Premium Increase(s):<br>DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: <a href="http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm">http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm</a> . | 36.22                                   | 20.40                                 | 56.62        |



| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>   | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 543  | <p>Air Track, Rotary or Percussion Drilling Machine &amp;/or Hammers, Blaster; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. &amp; Under); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb &amp; Gutter Machine; Concrete Spreader &amp; Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches &amp; A-Frames.</p> <p>Future Increase(s):<br/>           Add \$1.75/hr on 6/1/2014); Add \$1.25/hr on 6/1/2015);<br/>           Add \$1.30/hr on 6/1/2016); Add \$1.25/hr on 6/1/2017.</p> <p>Premium Increase(s):<br/>           DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day &amp; Christmas Day. 2) Add \$1.50/hr night work premium.<br/>           See DOT'S website for details about the applicability of this night work premium at: <a href="http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm">http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm</a>.</p> | 35.72                                   | 20.40                                 | 56.12        |
| 544  | <p>Backfiller; Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed &amp; Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Pile Driver &amp; Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine.</p>  | 33.96                                   | 19.79                                 | 53.75        |
| 545  | <p>Air Compressor (&amp;/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Automatic Belt Conveyor &amp; Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&amp;/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack.</p>  | 30.32                                   | 18.46                                 | 48.78        |
| 546  | Fiber Optic Cable Equipment.   | 26.69                                   | 16.65                                 | 43.34        |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |   | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|---|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>  | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 547  | Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.   | 38.80                                   | 20.17                                 | 58.97        |
| 548  | Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.  | 38.80                                   | 20.17                                 | 58.97        |
| 549  | Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or more); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.     | 34.50                                   | 20.04                                 | 54.54        |
| 550  | Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY. | 34.50                                   | 20.04                                 | 54.54        |

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

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |   | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|---|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>  | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 551  | Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads and/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic.  | 35.12                                   | 18.46                                 | 53.58        |
| 552  | Backhoe (Track Type) Having a Mfrgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver.<br>Future Increase(s):<br>Add \$1.75/hr on 6/1/2014); Add \$1.25/hr on 6/1/2015);<br>Add \$1.30/hr on 6/1/2016); Add \$1.25/hr on 6/1/2017.<br>Premium Increase(s):<br>DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium.<br>See DOT'S website for details about the applicability of this night work premium at: <a href="http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm">http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm</a> . | 36.22                                   | 20.40                                 | 56.62        |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |   | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|---|---|---------------------------------------|--------------|
| <b>CODE</b>  | <b>TRADE OR OCCUPATION</b>  | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 553  | Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Laser/Screed; Concrete Slipform Placer Curb & Gutter Machine; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames. | 32.89                                   | 18.96                                 | 51.85        |
| 554  | Backfiller; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self-Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler.  | 33.67                                   | 19.48                                 | 53.15        |
| 555  | Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack.<br>Future Increase(s):<br>Add \$1.75/hr on 6/1/2014); Add \$1.25/hr on 6/1/2015);<br>Add \$1.30/hr on 6/1/2016); Add \$1.25/hr on 6/1/2017.<br>Premium Increase(s):<br>DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium.<br>See DOT'S website for details about the applicability of this night work premium at: <a href="http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm">http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm</a> .   | 35.17                                   | 20.40                                 | 55.57        |
| 556  | Fiber Optic Cable Equipment.  | 26.69                                   | 16.65                                 | 43.34        |

|   |
|---|
| <b>RESIDENTIAL OR AGRICULTURAL CONSTRUCTION</b> |
|---|

Includes single family houses or apartment buildings of no more than four (4) stories in height and all buildings, structures or facilities that are primarily used for agricultural or farming purposes, excluding commercial buildings. For classification purposes, the exterior height of a residential building, in terms of stories, is the primary consideration. All incidental items such as site work, driveways, parking lots, private sidewalks, private septic systems or sewer and water laterals connected to a public system and swimming pools are included within this definition. Residential buildings of five (5) stories and above are NOT included within this definition.

|                       |
|-----------------------|
| <b>SKILLED TRADES</b> |
|-----------------------|

| Fringe Benefits Must Be Paid On <u>All</u> Hours Worked |  | HOURLY<br>BASIC RATE<br>OF PAY | HOURLY<br>FRINGE<br>BENEFITS | TOTAL |
|---|--|--------------------------------|------------------------------|-------|
| <u>CODE</u>   | <u>TRADE OR OCCUPATION</u>   | \$                             | \$                           | \$    |
| 101   | Acoustic Ceiling Tile Installer<br>Future Increase(s):<br>Add \$1.25/hr on 6/2/2014. | 33.68                          | 19.81                        | 53.49 |
| 102   | Boilermaker  | 26.00                          | 4.73                         | 30.73 |
| 103   | Bricklayer, Blocklayer or Stonemason   | 32.01                          | 13.26                        | 45.27 |
| 104   | Cabinet Installer  | 22.00                          | 1.05                         | 23.05 |
| 105   | Carpenter  | 30.48                          | 3.24                         | 33.72 |
| 106   | Carpet Layer or Soft Floor Coverer   | 23.68                          | 3.20                         | 26.88 |
| 107   | Cement Finisher  | 20.93                          | 5.94                         | 26.87 |
| 108   | Drywall Taper or Finisher  | 22.50                          | 0.88                         | 23.38 |
| 109   | Electrician  | 27.50                          | 7.47                         | 34.97 |
| 110   | Elevator Constructor   | 42.86                          | 23.84                        | 66.70 |
| 111   | Fence Erector  | 18.52                          | 4.89                         | 23.41 |
| 112   | Fire Sprinkler Fitter  | 52.82                          | 5.54                         | 58.36 |
| 113   | Glazier  | 38.03                          | 13.42                        | 51.45 |
| 114   | Heat or Frost Insulator  | 30.00                          | 0.00                         | 30.00 |
| 115   | Insulator (Batt or Blown)  | 19.00                          | 14.33                        | 33.33 |
| 116   | Ironworker   | 31.25                          | 19.46                        | 50.71 |
| 117   | Lather   | 30.48                          | 3.24                         | 33.72 |
| 119   | Marble Finisher  | 26.89                          | 19.18                        | 46.07 |
| 120   | Marble Mason   | 32.01                          | 13.26                        | 45.27 |
| 121   | Metal Building Erector   | 17.00                          | 3.82                         | 20.82 |
| 123   | Overhead Door Installer  | 12.00                          | 0.00                         | 12.00 |
| 124   | Painter  | 20.00                          | 4.22                         | 24.22 |

| Fringe Benefits Must Be Paid On <u>All</u> Hours Worked |                                  | HOURLY<br>BASIC RATE<br>OF PAY | HOURLY<br>FRINGE<br>BENEFITS | TOTAL |
|---|----------------------------------|--------------------------------|------------------------------|-------|
| <u>CODE</u>   | <u>TRADE OR OCCUPATION</u>       | \$                             | \$                           | \$    |
| 125   | Pavement Marking Operator        | 30.00                          | 0.00                         | 30.00 |
| 129   | Plasterer                        | 25.00                          | 0.00                         | 25.00 |
| 130   | Plumber                          | 30.00                          | 10.62                        | 40.62 |
| 132   | Refrigeration Mechanic           | 19.75                          | 8.56                         | 28.31 |
| 133   | Roofer or Waterproofer           | 17.00                          | 3.72                         | 20.72 |
| 134   | Sheet Metal Worker               | 21.03                          | 3.40                         | 24.43 |
| 135   | Steamfitter                      | 31.72                          | 16.10                        | 47.82 |
| 137   | Teledata Technician or Installer | 24.75                          | 8.09                         | 32.84 |
| 138   | Temperature Control Installer    | 22.50                          | 0.70                         | 23.20 |
| 139   | Terrazzo Finisher                | 26.89                          | 19.18                        | 46.07 |
| 140   | Terrazzo Mechanic                | 30.20                          | 18.42                        | 48.62 |
| 141   | Tile Finisher                    | 23.77                          | 16.50                        | 40.27 |
| 142   | Tile Setter                      | 21.00                          | 0.00                         | 21.00 |
| 143   | Tuckpointer, Caulker or Cleaner  | 32.50                          | 0.02                         | 32.52 |
| 146   | Well Driller or Pump Installer   | 27.60                          | 5.80                         | 33.40 |
| 147   | Siding Installer                 | 20.18                          | 0.00                         | 20.18 |

**TRUCK DRIVERS**

| Fringe Benefits Must Be Paid On <u>All</u> Hours Worked |                            | HOURLY<br>BASIC RATE<br>OF PAY | HOURLY<br>FRINGE<br>BENEFITS | TOTAL |
|---|----------------------------|--------------------------------|------------------------------|-------|
| <u>CODE</u>   | <u>TRADE OR OCCUPATION</u> | \$                             | \$                           | \$    |
| 201   | Single Axle or Two Axle    | 28.05                          | 4.16                         | 32.21 |
| 203   | Three or More Axle         | 18.00                          | 2.37                         | 20.37 |
| 205   | Pavement Marking Vehicle   | 18.00                          | 2.37                         | 20.37 |
| 207   | Truck Mechanic             | 19.00                          | 1.85                         | 20.85 |

**LABORERS**

| Fringe Benefits Must Be Paid On <u>All</u> Hours Worked |                            | HOURLY<br>BASIC RATE<br>OF PAY | HOURLY<br>FRINGE<br>BENEFITS | TOTAL |
|---|----------------------------|--------------------------------|------------------------------|-------|
| <u>CODE</u>   | <u>TRADE OR OCCUPATION</u> | \$                             | \$                           | \$    |
| 301   | General Laborer            | 18.14                          | 10.16                        | 28.30 |
| 302   | Asbestos Abatement Worker  | 17.00                          | 3.86                         | 20.86 |

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>                          | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 303  | Landscaper   | 30.00                                   | 0.00                                  | 30.00        |
| 311  | Fiber Optic Laborer (Outside, Other Than Concrete Encased) | 18.31                                   | 12.67                                 | 30.98        |
| 315  | Final Construction Clean-Up Worker                         | 16.00                                   | 0.00                                  | 16.00        |

**HEAVY EQUIPMENT OPERATORS  
RESIDENTIAL OR AGRICULTURAL CONSTRUCTION**

| <b>Fringe Benefits Must Be Paid On <u>All</u> Hours Worked</b> |  | <b>HOURLY<br/>BASIC RATE<br/>OF PAY</b> | <b>HOURLY<br/>FRINGE<br/>BENEFITS</b> | <b>TOTAL</b> |
|--|--|---|---------------------------------------|--------------|
| <b><u>CODE</u></b>   | <b><u>TRADE OR OCCUPATION</u></b>  | <b>\$</b>                               | <b>\$</b>                             | <b>\$</b>    |
| 557  | Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type); Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Crane, Shovel, Dragline, Clamshells; Forestry Equipment, Timberco, Tree Shear, Tub Grinder, Processor; Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type); Winches & A-Frames. | 29.70                                   | 20.08                                 | 49.78        |
| 558  | Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Backfiller; Belting, Burlap, Texturing Machine; Boiler (Temporary Heat); Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Jeep Digger; Lift Slab Machine; Mulcher; Oiler; Post Hole Digger or Driver; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Rock, Stone Breaker; Roller (Rubber Tire, 5 Tons or Under); Screed (Milling Machine); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Stump Chipper; Telehandler; Vibratory Hammer or Extractor, Power Pack.   | 29.70                                   | 16.00                                 | 45.70        |

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