BID OF_____

2012

PROPOSAL, CONTRACT, BOND AND SPECIFICATIONS

FOR

FIRE STATION NO. 2 REMODEL

CONTRACT NO. 6586

IN

MADISON, DANE COUNTY, WISCONSIN

AWARDED BY THE COMMON COUNCIL
MADISON, WISCONSIN ON_____

PLEASE RETURN PLANS AND SPECIFICATIONS TO:

CITY ENGINEERING DIVISION
1600 EMIL STREET
MADISON, WISCONSIN 53713

www.cityofmadison.com/business/pw

FIRE STATION NO. 2 REMODEL
CONTRACT NO. 6586

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This Proposal, and Agreement have
been prepared by:

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



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

SECTION A: ADVERTISEMENT FOR BIDS

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

A BEST VALUE CONTRACTING MUNICIPALITY

CONTRACT NO.	PROJECT NAME:
6586	fire station no. 2 remodel
SBE GOAL	10%

Plans and Specifications are available at 1600 Emil Street, Madison, WI 53713; 608-267-1197 or on our website at www.cityofmadison.com/business/pw/contracts/openforBid.cfm.

PREQUALIFICATIONS

Bidders who have not been prequalified by the City Engineer and Affirmative Action Director for the period of **February 1, 2012 to January 31, 2013** must submit their application on or before 1:00 p.m., APRIL 20, 2012, Room 115, City-County Building, Madison, WI 53703. Postmark is not applicable. Contractors be prequalified by the City Engineer including an affirmative action plan approved by the Affirmative Action Director prior to the bid opening or the bid will be rejected. Forms are available at the same location or on our website at www.cityofmadison.com/business/pw/forms.cfm.

PRE-BID MEETING

Representatives of the Affirmative Action Department will be present to discuss the Small Business Enterprise requirements on APRIL 13, 2012 at 1:00 PM at 1600 Emil Street, Madison Wisconsin.

OTHER REQUIREMENTS

Sealed bids 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.

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

Deadline for the Submittal of Bid is APRIL 20, 2012 by 1:00 PM, at 1600 Emil Street, Madison, WI 53713.

Bid Opening will be on APRIL 27. 2-12 at 1:30 PM at 1600 Emil Street, Madison, WI 53713.

REQUEST FOR BIDS FOR PUBLIC WORKS CONSTRUCTION FOR THE CITY OF MADISON, WISCONSIN

A BEST VALUE CONTRACTING MUNICIPALITY

Plans and Specifications for Public Works Projects that are open for bid are available on the City of Madison website at http://www.cityofmadison.com/business/PW/contracts/openforBid.cfm or by calling City Engineering at 608-266-4751.

Sealed bids 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.

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

Bidders must be prequalified with the City Engineer and the Affirmative Action Director. Deadline date for submittal of application is noticed on our website. Forms are available on the web at http://www.cityofmadison.com/business/pw/forms.cfm or by contacting City Engineering at 608-266-4620

Publ. WSJ MARCH 30, & APRIL 6 * 13, 2012

SECTION B: INSTRUCTIONS TO BIDDERS

The City of Madison Standard Specifications for Public Works Construction - 2012 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 at www.cityofmadison.com/Business/PW/specs.cfm or by contacting City Engineering Division, Room 115, City-County Building, 210 Martin Luther King Jr. Blvd., Madison, WI 53703.

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 Madison 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 Madison General Ordinances (entitled Affirmative Action) and as required by Section 102.11 of the Standard Specifications.

Section 102.4: Proposals

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 musts 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 therefore 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. Proposals will be received at the place and until the hour on the date designated in the advertisement. When sent by mail, the sealed proposal marked as indicated above shall be enclosed in an additional envelope. Proposals sent by mail, submitted in person or otherwise delivered must be in the hands of the official conducting the letting by the hour on the date designated in the advertisement. Proposals received after the date designated will be returned to the bidder unopened.

The Bidder shall execute form ERD-7777 (R.9/03), a part of these proposal pages and submit same with the bidder's proposal, if applicable. REFER TO PROPOSAL SECTION.

Section 102.5: Bid Deposit (Proposal Guaranty)

No proposal shall be considered unless either (i) it is accompanied by a bid deposit of the character and amount described in the Advertisement for Bids or (ii) a biennial bid bond in an amount and form acceptable to the City of Madison has been previously submitted.

Bid deposits of unsuccessful bidders shall be returned following the award of the contract by the Common Council. Bid deposit of the successful bidders shall be returned within forty-eight (48) hours following execution of the contract and bond as required.

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. Concrete Work
221 ☐ Concrete Bases and Other Concrete Work
225 ☐ Dredging
230 ☐ Fencing
235 ☐ Fiber Optic Cable/Conduit Installation
240 ☐ Grading and Earthwork
242 ☐ Infrared Seamless Patching
245 ☐ Landscaping, Maintenance
250 ☐ Landscaping, Site and Street
251 ☐ Parking Ramp Maintenance
255 ☐ Pavement Sealcoating and Crack Sealing
260 ☐ Petroleum Above/Below Ground Storage Tank Removal/Installation
265 ☐ Retaining Walls, Precast Modular Units
270 ☐ Retaining Walls, Reinforced concrete
275 ☐ Sanitary, Storm Sewer & Water Main Const.
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
330 ☐ Traffic Control During Construction
320 ☐ Traffic Signals
325 ☐ Traffic Signing & Marking
335 ☐ Trucking
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
437 ☐ Metals
440 ☐ Painting and Wallcovering
445 ☐ Plumbing
450 ☐ Pump Repair
455 ☐ Pump Systems
460 ☐ Roofing and Moisture Protection
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: http://www.dhs.wisconsin.gov/Asbestos/Cert/Index.htm. State of Wisconsin Performance of Asbestos Abatement Certificate must be attached.

6 ☐ Other_____

SECTION C: SBE

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.

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. 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 in a separate sealed envelope marked: **"ENVELOPE 2 - SBE COMPLIANCE REPORT."** 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-7; and
2.4.2.1.2 **Summary Sheet,** C-8.

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-7;
2.4.2.2.2 **Summary Sheet,** C-8; and
2.4.2.2.3 **SBE Contact Report,** C-9 and C-10. (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 with annual gross receipts of less than $750,000 when averaged over the past three year period;

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.

FIRE STATION NO. 2 REMODEL
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Small Business Enterprise Compliance Report

Cover Sheet

This information MUST be submitted in a separate sealed envelope marked "ENVELOPE NO. 2 - SBE COMPLIANCE REPORT."

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

FIRE STATION NO. 2 REMODEL
CONTRACT NO. 6586

Small Business Enterprise Compliance Report

Summary Sheet

This information MUST be submitted in a separate sealed envelope marked "ENVELOPE NO. 2 - SBE COMPLIANCE REPORT."

SBE SUBCONTRACTORS WHO ARE NOT SUPPLIERS

Name(s) of SBEs Utilized	Type of Work	% of Total Bid Amount

Subtotal SBE who are not suppliers: _____ %

SBE SUBCONTRACTORS WHO ARE SUPPLIERS

Name(s) of SBEs Utilized	Type of Work	% of Total Bid Amount

Subtotal Contractors who are suppliers: _____ % x 0.6 = _____ % (discounted to 60%)

Total Percentage of SBE Utilization: _____%.

FIRE STATION NO. 2 REMODEL
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Small Business Enterprise Compliance Report

SBE Contact Report

This information MUST be submitted in a separate sealed envelope marked "ENVELOPE NO. 2 - SBE COMPLIANCE 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

FIRE STATION NO. 2 REMODEL
CONTRACT NO. 6586

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: MINIMUM RATE OF WAGE SCALE

For this project, payment of prevailing wages (white sheet) is not required if either: a single trade accounts for 85% or more of the total labor costs of the project and the bid is less than $48,000; or no single trade accounts for 85% or more of the total labor costs of the project and the bid is less than $100,000. For bids not meeting either of these conditions, prevailing wages shall be required.

If required, the wages and benefits paid on the contract shall not be less than those specified in the Prevailing Wage Determination included with these contract documents for the following types of work:

- ☒ Building and Heavy Construction
- ☐ Sewer, Water, and Tunnel Construction
- ☐ Local Street and Miscellaneous Paving Operations
- ☐ Residential and Agricultural Construction

All bidders are notified that all labor employed on City contracts must be paid in accordance with the minimum rate of wage scale included in the Contract Documents.

For the information of the employees working on the project, a copy of the wage scale included in the contract documents and the provisions of Section 66.0903(8) of the Wisconsin Statutes shall be kept posted by the employer and in at least one conspicuous and easily accessible place at the site of the project.

The Contractor shall keep weekly payroll records setting forth the name, address, telephone number, classification, wage rate and fringe benefit package of each employee who worked on such City project and all other projects the employee worked in the same period, and the Contractor must 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. Such records shall, in addition, set forth the full weekly wages earned by each such employee and the actual hourly wage paid to that employee. The Contractor shall submit payroll records to the Engineer every week for those periods when work is being done on the project. Said submittal shall be within twenty-one (21) calendar days of the end of the Contractor's weekly pay period.

The Contractor shall ensure that employees shall be paid unconditionally and shall receive the full amounts accrued at the time of payment, computed at rates not less than those stated in the City of Madison "Minimum Rate of Wage Scale" and that 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 such employee. Questions regarding an employee's classification or rate of pay within that classification, shall

be resolved by the practice that predominates in the industry and on which the trade or occupation rate/classification is based. Therefore, rate of pay, classification and work jurisdiction disputes shall be resolved by relying upon practices established by collective bargaining agreements and guidelines used in such determinations by appropriate recognized trade unions operating within the City of Madison.

The Contractor shall agree that the normal rate of wage paid to the Contractor's employees on other projects shall not be reduced or otherwise diminished as a result of the requirement to pay no less than the minimum rate of wage scale on a City project. Mulcting of employees on City projects by contractors, such as by kickbacks or other such devices, is prohibited.

These contract provisions shall apply to all work performed on the contract by the Contractor with its own organization and with assistance of laborers under its immediate superintendency and to all work performed by piecework or by subcontract. No laborer, worker, or mechanic shall be employed directly upon the site of the work except on a wage basis, but this shall not be construed to prohibit the rental of equipment from individuals.

In the event of a refusal by the Contractor to submit payroll records as required by the contract, the City of Madison shall have the option to cancel this contract and request the Surety to perform or to relet the balance of the work for bids, and in that event, to charge the Contractor for any loss which the City may incur thereby.

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 $51,500 for a single trade contract; or equal to or greater than $251,000 for a multi-trade contract pursuant to MGO 33.07(7).

SECTION 105.1: AUTHORITY OF THE ENGINEER

The Engineer shall resolve all questions which arise as to the quality and acceptability of materials furnished, work performed, manner of performance, rate of progress of the work, interpretation of the plans and Specifications, acceptable fulfillment of the contract, compensation, and disputes and mutual rights between Contractors under the Specifications. The Engineer shall determine the amount and quantity of work performed and materials furnished.

All decisions of the Engineer shall, when so requested, be rendered in writing. They shall be final and conclusive in all matters unless within ten (10) days after such decision the Contractor applies in writing to the Board of Public Works for a review of such decision.

Any change proposed by a Contractor in SBE subcontractors, vendors or suppliers from those SBEs indicated on the SBE Compliance Report must be approved by the Engineer and the City's Manager of the Affirmative Action Division (hereafter, AAD). When requested, such decision shall be rendered in writing. Such decisions shall be final and conclusive in all matters unless within ten (10) days after such decision the Contractor or the affected SBE applies in writing to the Board of Public Works for a review of such decision.

In the event the Engineer and the AAD disagree over the proper decision to be made regarding an SBE, the Mayor shall appoint a third person to resolve the disagreement, within 30 days of appointment. The decision thus rendered may be reviewed by the Board of Public Works upon request of the Contractor or the affected SBE as set forth in Sections 105.1 and 105.2 of the City's standard specifications.

COMPLETION DATE

Construction work must begin within seven (7) calendar days after the date appearing on mailed 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 within **TWO HUNDRED TEN (224) CALENDAR DAYS**, the rate of progress and the time of completion being essential conditions of this Agreement.

PRODUCT OPTIONS AND SUBSTITUTIONS

Materials and equipment for this project shall be from items specified or items approved as equal, in writing, by the Architect at least eight (8) 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 General 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.

GENERAL INFORMATION

Obtain and pay for permits and fees required for this project.

Obtain and pay for construction sets of plans and specifications required for this project.

Prior to bidding, visit site to become familiar with and verify existing job conditions.

Do not scale drawings for exact dimensions.

Work shall comply with applicable codes and regulations.

Schedule initial work with Assistant Chief Paul Bloom at 266-5956, at least 48 hours in advance.

Contractor shall be responsible for restoring, repairing and/or replacing any materials, equipment or site damage caused by the work of this project to its original finish and/or condition.

Work shall be performed by mechanics 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.

The intent of the plans and specifications is to provide for the construction, execution and completion of a complete work or improvements, which the contractor undertakes to do in full compliance with the plans, specifications, and contract. The Contractor shall perform all items of work covered and stipulated in the proposal and perform altered and extra work necessary to the prosecution and completion of the work.

The Contractor shall take no advantage of any apparent error or omission in the plans or specifications, and the Owner shall be permitted to make such corrections and interpretations as may be deemed necessary for the fulfillment of the intent of the plans and specifications.

Conditions of the Contract and Division I Specification Sections are applicable to all Divisions of the Specifications and Drawings.

QUESTIONS

Questions pertaining to this project shall be directed to Dale Volkening at Strang Inc., 6411 Mineral Point Road, Madison, WI 53705, 608-276-9200.

The project is to remodel and construct a building addition with site improvements for Fire Station No. 2 located at 421 Grand Canyon Drive, Madison, Wisconsin. The 2-story remodel area is around 4,385 square feet. The 2-story building addition area is around 390 square feet.

01200 SPECIAL PROJECT REQUIREMENTS

All work must be performed during the hours of 7:00 a.m. and 6:00 p.m., Monday through Friday.



CITY OF MADISON
FIRE STATION #2
ADDITION AND REMODELING
OWNER REVIEW

MADISON WISCONSIN

PROJECT #2012 009

March 9, 2012

SECTION 01 10 00 - SUMMARY OF WORK:

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 PROJECT/WORK IDENTIFICATION:

General: Name of project is City Of Madison, Fire Station #2 Addition And Remodeling located at 421 Grand Canyon Drive, Madison, WI on contract documents by the Architect, STRANG, INC., 6411 Mineral Point Road, Madison, Wisconsin 53705-4395.

A. The work will be competed under a single prime contract with one bid package for all work.

In general the work consists of an addition and alteration to the existing fire station encompassing an approximate area of 2,700 square feet on 2 floors. The following construction trades and services are required: Site Utilities, Excavation and Site Restoration, General Construction, Fire Protection, Plumbing, HVAC, Electrical.

1.3 WORK BY OTHERS:

A. Owner will award separate contracts for the following listed construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract. Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

1. The Providing of electric locksets on exterior doors.
2. The Providing of radio equipment.
3. The Providing of tele-data devices and equipment.
4. Weatherization of exterior walls.
5. Asbestos abatement work.

1.4 COORDINATION:

A. General: The Contract for General Construction includes coordination of entire work of project from the beginning of activity through the project closeout and warranty periods.

B. Performance Requirements for Completed Work:

1. General: The contract documents indicate intended occupancy and utilization of building and its individual systems and facilities. Compliance with governing regulations is intended and required, for the work and for Owner's occupancy and utilization. It is required that every element of the work complies with applicable requirements of contract documents and all building systems are complete and fully operational.

1.5 ALTERNATES:

A. Definitions: Alternates are defined as alternate products, materials, equipment or systems for the work which may, at Owner's option and under terms established by Instructions to Bidders, be selected and recorded in the prime Contracts (Owner-Contractor Agreements) to either supplement or displace corresponding basic requirements of contract documents. Alternates may or may not substantially change scope and general character of the work; and must not be confused with "change orders," "substitutions," and other similar provisions.

B. General Provisions: Refer to Division 1 Section - "Alternates." The alternate is defined by abbreviated language, recognizing that drawings and specification sections document the requirements. Coordination of related work is required to ensure that work affected by each selected alternate is complete and properly interfaced with work of alternates.

1.6 USE OF THE PREMISES

A. The Owner will vacate the existing building during the entire construction period. Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. The Contractor's use of premises is limited only by Owner's right to perform work and to retain other contractors on portions of Project.

B. Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building during construction period.

C. Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.
2. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.7 PERMITS AND FEES

A. Owner will obtain State of Wisconsin Department of Commerce approval of building, HVAC, and plumbing plans.

B. General Contractor shall obtain the local building permit, including payment of fees.

C. All other permits, licenses and inspections shall be obtained by each trade as required for performing the work, including payment of fees.

1.8 WARRANTY

A. All work shall be warranted against defects in materials and workmanship for a period of one (1) year from date of final acceptance by the Owner. The warranty shall specifically provide that all defects in materials and workmanship appearing during the warranty period, as determined by the Owner, will be remedied at no additional cost to the Owner.

CITY OF MADISON
FIRE STATION #2 ADDITION AND REMODELING
Project No. 2011 009

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Not Used.

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1.9 MUTUAL RESPONSIBILITY

A. All contractors shall coordinate their Work with adjacent Work and shall cooperate with with all other trades so as to facilitate the general progress of the Work.

B. Each contractor shall give due notice and proper information to other contractors of any special provisions necessary for placing or setting of his work coming in contact with work of other contractors.

1.10 FIELD MEASUREMENTS AND INSPECTION OF SURFACES

A. Each contractor shall obtain complete data at the site and inspect surfaces that are to receive his work before proceeding with fabricating, assembling, fitting, and erecting his work. He shall be responsible for the accuracy of measurements and laying out of the work.

B. Each contractor, as it applies to his work, shall verify grades, lines, levels, locations, and dimensions as shown on the Drawings, and report any inconsistencies to the Architect before commencing work. Starting of work by the contractor implies his acceptance.

1.11 MISCELLANEOUS AND GENERAL PROVISIONS:

A. Cutting and Patching:

1. Definition: Includes cutting and patching of both previously existing work and nominally completed portions of Contract work. Excludes shop fabrication of work and normal installation procedures including the drilling of holes to install fasteners. Excludes special categories of work identified as alterations, demolition, excavating, grading, planting, cleaning, removal/replacement of noncomplying work and similar activities; although some of these activities may require cutting and patching.

B. Mechanical/Electrical Provisions of General Work:

1. General: Except as otherwise indicated, comply with applicable requirements of Division 22 & 23 sections for mechanical provisions within units of general work and comply with applicable requirements of Division 26 - 28 sections for electrical provisions within units of general work. Refer to Division 22 through Division 28 sections where applicable for characteristics of mechanical and electrical services to be connected to units of general work and provide units manufactured/fabricated for proper connection and utilization of available services as indicated.

1.12 HAZARDOUS MATERIALS SURVEY:

A. Asbestos Inspection: an inspection has been made for the presence of asbestos-containing materials. A copy of the report is attached at the end of this section.

B. Lead Paint Inspection: an inspection has been made for the presence of lead paint. A copy of the report is attached at the end of this section.

C. Abatement of asbestos-containing material will be done by the Owner as a separate project.

D. Removal of lead paint shall be the responsibility of the Contractor. Methods of removal and disposal shall be in conformance with the requirements of regulatory authorities.

PART 2 - PRODUCTS

Not applicable

PART 3 - EXECUTION

Not applicable

END SECTION 01 10 00

A & A Environmental, Inc.

N4381 US Hwy 51 • Poynette, WI 53955
Phone: (608) 240-1511 • Mobile Phone: (608) 576-4960 • Fax: (608) 635-9717

January 30, 2012

Mr. James C. Whitney
City of Madison
215 Martin Luther King Jr. Blvd, Room 115
Madison, WI 53703
(608) 266-4563, Fax (608) 264-9275, Cell (608) 575-5269

RE: Fire Station #2, 421 Grand Canyon Drive, Madison, WI

On January 20, 2012 bulk samples were collected of building materials that will be disturbed during renovation of Fire Station #2 located at 421 Grand Canyon Drive in Madison, WI. The bulk samples collected were analyzed for asbestos content by polarized light microscopy.

The following building materials sampled were reported to contain > 1% asbestos.

1. 12 x 12 floor tile and mastic in the workout room (660 Sq Ft).
2. 12 x 12 floor tile and mastic under carpet in the lounge (816 Sq Ft).

The carpet will most likely pull up some of the floor tile. The carpet should be removed by the abatement contractor.

Bulk samples collected of building materials that were reported as no asbestos detected are as follows:

1. Kitchen drywall, wall.
2. Kitchen drywall compound, wall.
3. Kitchen drywall tape, wall.
4. Kitchen drywall texture, wall.
5. Drywall ceiling tiles.
6. Ceramic wall tile grout/thinset.
7. 2 x 4 ceiling tiles.
8. TSI fitting insulation cement plumbing line.
9. Yellow glue on kitchen wall tile slop sink.
10. Second floor drywall, wall.
11. Second floor drywall compound, wall.
12. Second floor 2 x 4 ceiling tiles.
13. Second floor carpet mastic, yellow/blue/green.
14. Exterior window calking.

Other building materials not on this list or found during the course of renovation must be assumed to contain asbestos. All roofing material on this project is assumed to contain asbestos, Category I, non-friable.

Please note: This project requires a DNR Form 4500-113 and a$135.00 fee if structural components are being removed from the building during renovation.

A&A Environmental Inc.'s inspectors are only able to inspect open, safe, and accessible areas inside and outside of the building. Inaccessible suspect material may be hidden throughout this building. Any additional suspect materials discovered during the course of abatement/demolition/remodeling must be assumed to be ACM until sampled by and EPA/State of Wisconsin certified asbestos inspector and proven negative.

If you have any questions concerning this report or the sampling performed please feel free to contact me.

Sincerely,

Kim Sopha
President/Inspector #AII01851

Encl

KAS/bls

EMC LABS, INC.

9830 S. 51st Street, Suite B109, Phoenix, AZ 85044
Phone: 800-362-3373 or 480-940-5294 - Fax: (480) 893-1726

Laboratory Report
0108552

Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	A & A ENVIRONMENTAL, INC.	Job# / P.O. #:	AA2886
Address:	N4381 US HWY 51 POYNETTE WI 53955	Date Received:	01/23/2012
		Date Analyzed:	01/25/2012
Collected:	01/20/2012	Date Reported:	01/25/2012
Project Name/ Address:	FIRE STATION #2	EPA Method:	EPA 600/M4-82-020
		Submitted By:	KIM SOPHA
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type	(%)	Non-Asbestos Constituents	
0108552-001 01	KITCHEN	Drywall, White/ Brown	No			Cellulose Fiber Gypsum Mica Binder/Filler	10% 90%
0108552-002 02	KITCHEN	LAYER 1 Drywall Compound, Off White	No			Cellulose Fiber Carbonates Mica Binder/Filler	<1% 99%
		LAYER 2 Tape, Off White	No			Cellulose Fiber Binder/Filler	95% 5%
		LAYER 3 Texture, White/ Off White	No			Cellulose Fiber Carbonates Mica Binder/Filler	<1% 99%
0108552-003 03	KITCHEN	Ceiling Tile/ Drywall, White/ Brown	No			Cellulose Fiber Fibrous Glass Gypsum Carbonates Mica Binder/Filler	10% 1% 89%
0108552-004 04	KITCHEN WALL	Ceramic Tile Grout/ Thin Set, Lt. Gray	No			Carbonates Quartz Binder/Filler	 100%
0108552-005 05	WORKOUT RM	12"x12" Floor Tile, Beige/ Brown	Yes	Chrysotile	3%	Carbonates Gypsum Quartz Binder/Filler	 97%
0108552-006 06	WORKOUT RM	Mastic, Black	Yes	Chrysotile	5%	Fibrous Glass Carbonates Gypsum Quartz Binder/Filler	2% 93%

EMC LABS, INC.

9830 S. 51st Street, Suite B109, Phoenix, AZ 85044
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Collected:	01/20/2012	Date Reported:	01/25/2012
Project Name/	FIRE STATION #2	EPA Method:	EPA 600/M4-82-020
Address:		Submitted By:	KIM SOPHA
		Collected By:	

Lab ID / Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0108552-007 07	WORKOUT RM	2x4 Ceiling Tile, White/ Beige	No		Cellulose Fiber Mineral Wool Carbonates Perlite Binder/Filler	70% 5% 25%
0108552-008 08	MECHANICAL RM	TSI Fitting, Beige	No		Mineral Wool Cellulose Fiber Gypsum Mica Perlite Carbonates Binder/Filler	30% <1% 69%
0108552-009 09	SLOP SINK IN KITCHEN AREA	LAYER 1 Ceramic Tile, White	No		Cellulose Fiber Gypsum Quartz Binder/Filler	<1% 99%
		LAYER 2 Grout, Gray	No		Carbonates Quartz Binder/Filler	 100%
0108552-010 10	SLOP SINK IN KITCHEN AREA	Glue, Yellow	No		Cellulose Fiber Gypsum Quartz Binder/Filler	<1% 99%
0108552-011 11	UPPER FL SLEEPING RM	Drywall, White/ Brown	No		Cellulose Fiber Gypsum Carbonates Quartz Binder/Filler	10% 90%

EMC LABS, INC.

9830 S. 51st Street, Suite B109, Phoenix, AZ 85044
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Project Name/	FIRE STATION #2	EPA Method:	EPA 600/M4-82-020
Address:		Submitted By:	KIM SOPHA
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0108552-012 12	UPPER FL SLEEPING RM	Drywall Compound, White/ Yellow	No			
					Carbonates Mica Binder/Filler	100%
0108552-013 13	UPPER FL SLEEPING RM	2x4 Ceiling Tile, White/ Beige	No		Cellulose Fiber	70%
					Carbonates Perlite Binder/Filler	30%
0108552-014 14	UPPER FL SLEEPING RM	Carpet Mastic, Yellow/ Blue/ Green	No		Synthetic Fiber	3%
					Gypsum Quartz Binder/Filler	97%
0108552-015 15	EXTERIOR WINDOW OFFICE	Window Caulk, Dk. Brown	No			
					Gypsum Carbonates Quartz Binder/Filler	100%

Analyst - Paul Hofer

Signatory - Lab Director - Kurt Kettler

Distinctly stratified, easily separable layers of samples are analyzed as subsamples of the whole and are reported separately for each discernable layer. All analyses are derived from calibrated visual estimate and measured in weight percent unless otherwise noted. The report applies to the standards or procedures identified and to the sample(s) tested. The test results are not necessarily indicated or representative of the qualities of the lot from which the sample was taken or of apparently identical or similar products, nor do they represent an ongoing quality assurance program unless so noted. These reports are for the exclusive use of the addressed client and that they will not be reproduced wholly or in part for advertising or other purposes over our signature or in connection with our name without special written permission. The report shall not be reproduced except in full, without written approval by our laboratory. The samples not destroyed in testing are retained a maximum of thirty days. The laboratory measurement of uncertainty for the test method is approximately <1% by weight. Accredited by the National Institute of Standards and Technology, Voluntary Laboratory Accreditation Program for selected test method for asbestos. The accreditation or any reports generated by this laboratory in no way constitutes or implies product certification, approval, or endorsement by the National Institute of Standards and Technology. The report must not be used by any entity to claim product endorsement by NVLAP or any agency of the U.S. Government. Polarized Light Microscopy may not be consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials.

A & A Environmental, Inc.

N4381 US Hwy 51 • Poynette, WI 53955
Phone: (608) 240-1511 • Mobile Phone: (608) 576-4960 • Fax: (608) 635-9717

January 30, 2012

Mr. James C. Whitney
City of Madison
215 Martin Luther King Jr. Blvd, Room 115
Madison, WI 53703
(608) 266-4563, Fax (608) 264-9275, Cell (608) 575-5269

RE: Fire Station #2, 421 Grand Canyon Drive, Madison, WI

On January 20, 2012 XRF sampling for lead in paint was completed in the following areas to determine if the painted concrete or cement block material is recyclable.

Laundry Area - Walls and floor, less than detectable levels - recyclable.

Garage Area - Floors less than detectable levels - recyclable.

Kitchen Area - Walls >0.7 Mg/Cm^2 - NOT recyclable.

If you have any questions concerning this report or the sampling performed please feel free to contact me.

Sincerely,

Kim Sopha

Kim Sopha
President/Inspector #LR01851

Encl

KAS/bls

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Fax: (608) 635-9717

CLIENT:	City of Madison	AA ENV #:	AA2886
LOCATION:	Fire station #2	SITE DATE	1/20/12
WORK AREA:	Fire station	INSPECTOR	Kim Sopha

Index	Type	Component	Substrate	Side	Condition	Color	Floor	Room	Results	PbC
1	CAL									3.01
2	PAINT			CAL					Positive	1
3	PAINT			CAL					Positive	1
4	PAINT			CAL					Positive	1.1
5	PAINT	WALL	CONCRETE BLOCK	A	INTACT	BEIGE	FIRST	LANDRY	Negative	< LOD
6	PAINT	WALL	CONCRETE BLOCK	B	INTACT	BEIGE	FIRST	LANDRY	Negative	< LOD
7	PAINT	WALL	CONCRETE BLOCK	C	INTACT	BEIGE	FIRST	LANDRY	Negative	< LOD
8	PAINT	WALL	CONCRETE BLOCK	D	INTACT	BEIGE	FIRST	LANDRY	Negative	< LOD
9	PAINT	FLOOR	CONCRETE		INTACT	RED	FIRST	LANDRY	Null	< LOD
10	PAINT	FLOOR	CONCRETE		INTACT	RED	FIRST	LANDRY	Negative	< LOD
11	PAINT	FLOOR	CONCRETE		INTACT	RED	FIRST	GARAGE	Negative	< LOD
12	PAINT	WALL	CONCRETE BLOCK	A	INTACT	WHITE	FIRST	KITCHEN	Positive	1.1
13	PAINT	WALL	CONCRETE BLOCK	B	INTACT	WHITE	FIRST	KITCHEN	Null	< LOD
14	PAINT	WALL	CONCRETE BLOCK	B	INTACT	WHITE	FIRST	KITCHEN	Null	< LOD
15	PAINT	WALL	CONCRETE BLOCK	B	INTACT	WHITE	FIRST	KITCHEN	Positive	1.2
16	PAINT			CAL					Null	0.9
17	PAINT			CAL					Positive	1.1
18	PAINT			CAL					Positive	1
19	PAINT			CAL					Positive	1

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. This Section includes administrative and procedural requirements governing Alternates.

1.3 DEFINITIONS:

A. Sum to incorporate the Alternate into the work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES:

A. Coordination: Modify or adjust affected adjacent work as necessary to completely and fully integrate that work into the project.

B. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.

C. Notification: Immediately following the award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate whether alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

D. Execute accepted alternates under the same conditions as other work of this contract.

E. Schedule: A "Schedule of Alternates" is included at the end of this section. Each alternate is defined by abbreviated language, recognizing that drawings and specification sections document the requirements.

PART 2 - PRODUCTS

Not applicable

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES:

Alternate No. 1 (ADD): State the amount to add to Base Bid to provide the concrete patio and the pergola on the exterior of the building.

Alternate No. 2 (ADD): State the amount to add to Base Bid to provide resinous flooring in Rooms 101, 102, 103, 104, and 105.

END SECTION 01 23 00

SECTION 01 31 00 - PROCEDURES AND PERFORMANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. The types of minimum requirements for procedural and performance work of a general nature to be fulfilled by the General Contractor include but are not necessarily limited to the following categories; and require participation by all subcontractors even though certain items of work may be assigned to General Contractor.

Coordination and meetings.
Meeting minutes.
Administrative/supervisory personnel.
Surveys and records or reports.
Limitations for use of site.
Special reports.
Tradesmen and workmanship standards.
Inspections, tests and reports.
General installation provisions.
Cutting and patching.
Cleaning and protection.

1.3 COORDINATION AND MEETINGS:

A. General: Contractor shall prepare a written memorandum of general instructions on required coordination activities including notices/reports/meetings and shall distribute memorandum to pertinent subcontractors. Contractor shall, with appropriate explanatory transmittal, distribute copy of memorandum to each engaged entity performing work at project site.

B. Coordination Drawings: Where work by separate entities requires off-site fabrication of products and materials which must be accurately interfaced and closely intermeshed to produce required results, prepare coordination drawings to indicate how the work shown by separate shop drawings will be interfaced, intermeshed and sequenced for installation. Comply with submittal requirements of "Submittals" section.

C. Regular Coordination Meeting: In addition to specific coordination meetings for each major element of work and regular project meetings for other purposes (as indicated elsewhere in the contract documents), Contractor shall schedule and hold general project coordination meetings at regularly scheduled times which are convenient for attendance by subcontractors and other entities then involved. Contractor shall prepare meeting minutes. Required attendance includes subcontractors and every other entity identified by Contractor as being currently involved in coordination or planning for the work (of the entire project).

D. Meeting Minutes: Prepare minutes of each meeting and distribute to entities as

designated.

1.4 ADMINISTRATIVE/SUPERVISORY PERSONNEL:

A. General: In addition to a Superintendent and other administrative and supervisory personnel required for performance of the work, each major sub-contractor shall provide specific coordinating personnel as reasonably required for interfacing work with other work of total project.

B. Project Coordinator: Contractor shall provide a full-time Project Coordinator who is experienced in administration and supervision of building construction including mechanical and electrical work and who is hereby authorized to act as the general coordinator of interfaces between the work of all subcontracts. For purpose of this provision "interface" is defined to include the scheduling and sequencing of work, sharing of access to work spaces, installations, protection of each other's work, cutting and patching, tolerances, cleaning, selections, for compatibility, preparation of coordination drawings, inspections, tests and temporary facilities and services.

1.5 SURVEYS AND RECORDS/REPORTS:

A. General: Working from lines and levels established by existing building lines, property survey and as shown in relation to the work, Contractor shall establish and maintain bench marks and other dependable markers to set lines and levels for the work at each story of construction and elsewhere on site as needed to properly locate each element of entire project. Contractor shall calculate and measure required dimensions as shown (within recognized tolerances if not otherwise indicated) and shall not scale drawings to determine dimensions. Advise tradesmen performing the work of marked lines and levels provided for their use in layout of work.

1.6 LIMITATIONS FOR USE OF SITE:

A. General: In addition to site utilization limitations and requirements shown on drawings and indicated by other contract documents, Contractor shall administer allocation of available space equitably among subcontractors and other entities needing access and space so as to produce best overall efficiency in performance of total work of project. Contractor shall schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site

1.7 SPECIAL REPORTS:

A. General: Except as otherwise indicated, submit special reports directly to Owner within one day of occurrence requiring special report with copy to Architect and others affected by occurrence.

B. Reporting Unusual Events: When an event of unusual and significant nature occurs at site (examples: visit by County/City officials plus news media; extraordinary weather phenomenon), Contractor shall prepare and submit a special report listing chain of events, persons participating, response by Contractor's personnel and by other Contractors' personnel, evaluation of results or effects and similar pertinent information. When such events are known or predictable in advance it is the responsibility of Contractor to advise Owner in advance at earliest possible date.

C. Reporting Accidents: Contractor shall prepare and submit reports of significant accidents at site and anywhere else work is in progress. Record and document data and actions; comply with industry standards. For this purpose, a significant accident is defined to include events where bodily injury is sustained or property loss of substance is sustained

or where the event posed a significant threat of loss or personal injury.

1.8 TRADESMEN AND WORKMANSHIP STANDARDS:

A. General: Contractor shall instigate and maintain procedures to ensure that tradesmen performing work at site are skilled and knowledgeable in methods and craftsmanship needed to produce required quality levels for workmanship in completed work. Remove and replace work which does not comply with workmanship standards as specified and as recognized in the construction industry for applications indicated. Remove and replace other work damaged or deteriorated by faulty workmanship or its replacement.

B. Availability of Tradesmen: At each progress or coordination meeting, Contractor shall review availability of tradesmen and projected needs to accomplish work as scheduled. Require each entity employing tradesmen to report on current and pending trade union actions and jurisdictional matters which might affect progress of work. Where possible dispute or delay is identified, consider alternatives and take actions to avoid disputes and delays.

1.9 INSPECTIONS, TESTS AND REPORTS:

A. General: Required inspection and testing services are intended to assist in determination of probable compliances of the work with requirements, but do not relieve any Contractor of responsibility for those compliances or for general fulfillment of requirements of contract documents. Specified inspections and tests are not intended to limit any prime Contractor's quality control program. Afford reasonable access to agencies performing tests and inspections.

PART 2 - PRODUCTS

Not applicable

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION PROVISIONS:

A. Preinstallation Conferences: Well in advance of installation of every major unit of work which requires coordination and interfacing with other work, contractor shall meet at project site with installers and representatives of manufacturers and fabricators who are involved in or affected by unit of work and in its coordination or integration with other work which has preceded or will follow. The Contractor shall advise Architect of scheduled meeting dates. At each meeting review progress of other work and preparations for particular work under consideration, including requirements of contract documents, options, related change orders, purchases, deliveries, shop drawings product data, quality control samples, possible conflicts, compatibility problems, time schedules, weather limitations, temporary facilities, space and access limitations, structural limitations, governing regulations, safety, inspection and testing requirements, required performance results, recording requirements and protection. Contractor shall record significant discussions of each conference and agreements and disagreements, along with final plan of action; and shall distribute record of meeting promptly to everyone concerned, including Architect.

B. Do not proceed with unit of work where associated preinstallation conference cannot be concluded successfully. Subcontractor with most involvement shall instigate actions to resolve impediments to performance of the work and reconvene conference at earliest

date feasible.

C. Installer's Inspection of Conditions: Installer of each major unit of work shall inspect substrate to receive the work and conditions under which the work will be performed and to report (in writing to prime Contractor) unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

D. Manufacturer's Instructions: Where installations include manufactured products, comply with manufacturer's applicable instructions and recommendations for installation to whatever extent these are more explicit or more stringent than applicable requirements indicated in contract documents.

E. Inspect each item of materials or equipment immediately prior to installation and reject damaged and defective items.

F. Provide attachment and connection devices and methods for securing work properly as it is installed; true to line and level and within recognized industry tolerances if not otherwise indicated. Allow for expansions and building movements. Provide uniform joint widths in exposed work, organized for best possible visual effect. Refer questionable visual effect choices to Architect for final decision.

G. Recheck measurements and dimensions of the work, as an integral step of starting each installation.

H. Install work during conditions of temperature, humidity, exposure, forecasted weather and status of project completion which will ensure best possible results for each unit of work, in coordination with entire work. Isolate each unit of work from noncompatible work, as required to prevent deterioration.

I. Coordinate enclosure (closing-in) of work with required inspections and tests, so as to avoid necessity of uncovering work for that purpose.

J. Mounting Heights: Except as otherwise indicated, mount individual units of work as shown on the drawings or specifications at industry recognized standard mounting heights, for applications indicated. Refer questionable mounting height choices to Architect for final decision.

K. Welding, Soldering, Use of Electric Arc Equipment, Use of Combustible Gas Equipment, Equipment Producing High Temperature Discharges: Take extra precautions to protect existing in-place construction from potential ignition from high heat producing processes. Provide non-combustible shields, guards, blankets and other available methods expressly developed for the purpose of protecting materials from combustion within the temperature ranges associated with each process.

3.2 CUTTING AND PATCHING:

A. General: Do not cut and patch structural work in a manner resulting in reduction of load carrying capacity or load/deflection ratio; submit proposed cutting and patching to Architect for structural approval before proceeding. Do not cut and patch operational elements and safety related components in a manner resulting in reduction of capacities to perform in manner intended or resulting in decreased operational life, increased maintenance or decreased safety. Do not cut and patch work which is exposed on exterior or exposed in occupied spaces of building, in a manner resulting in reduction of visual qualities or resulting in substantial evidence of cut and patch work, both as judged solely by Architect. Remove and replace work judged by Architect to be cut and patched

in a visually unsatisfactory manner.

B. Engage original Fabricator/Installer to perform cutting and patching of structural work, operational/safety related components and visually exposed work; or if not available, engage only recognized experts; employ only proven methods.

C. Materials: Except as otherwise indicated or approved by Architect, provide materials for cutting and patching which will result in equal or better work than work being cut and patched, in terms of performance characteristics and including visual effect where applicable. Use materials identical with original materials where feasible and where recognized that satisfactory results can be produced thereby.

D. Temporary Support and Protection: Provide adequate temporary support for work to be cut, to prevent failure. Do not endanger other work. Provide adequate protection of other work during cutting and patching to prevent damage and provide protection of the work from adverse weather exposure.

E. Cut work by methods least likely to damage work to be retained and work adjoining. Where physical cutting action is required, cut work with sawing and grinding tools, not with hammering and chopping tools. Core drill openings through concrete work. Comply with the requirements of applicable sections of Division 2 where cutting and patching requires excavating and backfilling.

F. Patch with seams which are durable and as invisible as possible. Comply with specified tolerances for the work. Where feasible, inspect and test patched areas to demonstrate integrity of work.

G. Restore exposed finishes of patched areas and where necessary extend finish restoration onto retained work adjoining, in a manner which will eliminate evidence of patching. Where patch occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing patch, after patched area has received prime and base coats.

3.3 CLEANING AND PROTECTION:

A. General: During handling and installation of work at project site, Contractor shall clean and protect work in progress and adjoining work on a basis of perpetual maintenance. Apply suitable protective covering on newly installed work where reasonably required to ensure freedom from damage or deterioration at time of substantial completion; otherwise, clean and perform maintenance on newly installed work as frequently as necessarily through remainder of construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

B. Limiting Exposures of Work: To extent possible through reasonable control and protection methods, Contractor shall supervise performance of work in a manner and by means which will ensure that none of the work whether completed or in progress, will be subjected to harmful, dangerous, damaging or otherwise deleterious exposures during construction period. Such exposures include (where applicable, but not by way of limitation) static loading, dynamic loading, internal pressures, external pressures, high or low temperatures, thermal shock, high or low humidity, air contamination or pollution, water, ice, solvents, chemicals, light, radiation, puncture, abrasion, heavy traffic, soiling, bacteria, insect infestation, combustion, electrical current, high speed operation, improper lubrication, unusual wear, misuse, incompatible interface, destructive testing, misalignment, excessive weathering, unprotected storage, improper shipping/handling, theft and vandalism.

1
2 END SECTION 01 31 00

SECTION 01 32 00 - SCHEDULES, REPORTS AND PAYMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 COORDINATION, GENERAL:

A. The Contractor shall provide close administrative and procedural coordination of scheduling/reporting/payment requesting and shall be responsive to overall coordination responsibilities assigned to the Contractor. Coordinate both the procedural timing and the listing (naming and sequencing) of reports/activities required by provisions of this section and other sections, to afford consistency and logical coordination between submitted reports or lists. Maintain coordination and correlation between separate reports by updating at monthly or shorter time intervals. Make appropriate distribution of each report and updated report to entities involved in the work including Architect/Engineer and Owner and including pertinent contractors where applicable. In particular, provide close coordination of progress schedule, schedule of values, listing of subcontracts, schedule of submittals, progress reports and payment requests.

1.3 FULLY DEVELOPED PROGRESS SCHEDULE:

A. Bar Chart Schedule: Based on preliminary development of progress schedules (if any) and whatever updating and feedback may have occurred during project start-up, Contractor shall, for entire work, secure critical time commitments for performing major elements of the work. Within 60 days of date established for "commencement of the work" submit a multi-sheet, comprehensive, integrated, bar chart type progress schedule indicating (by coded symbols) a time bar for each major category or unit of work to be performed at site and including minor units which are, nevertheless, involved in overall sequencing of the work. Show the work of subcontract on a summary sheet of the combined work. Arrange schedules to graphically show major sequences required in intermeshing of work and to show how substantial completion is scheduled to allow for Architect/Engineer's procedure for certification thereto. Prepare and maintain schedules on sufficiently wide sheets or series of sheets to show required data clearly for entire Construction Time and to permit reproduction for required distribution.

1. Individual Work Stages: By uniform targeted symbols and crosshatched bars, show significant stages for each category or unit of work including (where applicable), but not necessarily limited to, subcontract letting, submittals, purchases, mockups, fabrication, sample testing, deliveries, installation, testing, adjusting, curing, start-up and placement into final use and operation. Within long bars showing fabrication or installation of major units of work (3 months and longer) show estimated percentage of completion markers at 10 percent increments. As each unit of work progresses, mark each long bar with a contrasting mark (at 10 percent increments) to show actual percentage of completion.
2. Area Separations: Arrange schedules with individual time bars for each major area of construction of each major category or unit of work where it must be sequenced or intermeshed with other work as needed for structural completion,

permanent space enclosure, completion of mechanical/electrical work, substantial completion or other recognized stage of completion for overall work in that area. Except as otherwise indicated or subsequently agreed upon with Architect or Engineer, a "major area" is defined for purpose of this article to mean a story of construction.

3. Cost Correlation: Immediately below date line at heading of each prime contract bar chart, provide a double line cost correlation line ("precalculated" and "actual") to show dollar volume of work performed as of same dates used for preparation of payment requests. Refer to subsequent article for cost reporting and payment procedures. Use those same dates as primary vertical lines of schedule. Insofar as it is practical to do so, use same units of work in progress schedule as indicated in the "schedule of values" required by General Conditions and further specified herein.

   a. Superimpose an S curve on bar chart (only first sheet for multiple sheet schedules) to show "precalculated" dollar volume against time at any point during Contract Time; with double column of figures in left hand margin ranging from zero dollars to Contract Sum and from 0 percent to 100. As work progresses and on each date used in payment requests, plot a second S curve showing "actual" dollar volume of work performed.

4. Distribution: Following initial submittal to and response by Architect/Engineer, Contractor shall print and distribute progress schedules to Architect/Engineer (3 copies), Owner, contractor, principal subcontractors and suppliers or fabricators, and others with a need-to-know schedule compliance requirement. Post copies in project meeting room and field (temporary) offices. Distribute and post subsequent updated issues to same entities and locations when revision are made; except delete entities from distribution when they have completed assigned work and are no longer involved in performance of scheduled work.

1.4 SUBMITTAL SCHEDULE:

A. General: Immediately following development and acceptance of fully developed progress schedule, Contractor shall prepare a complete schedule of work related submittals. Submit each within 10 days of date required for establishment of related progress schedule. Correlate each submittal schedule with listing of principal subcontractors, as required by the General Conditions and with the "listing of products" or "procurement schedule" as specified in "Products" sections and elsewhere in contract documents.

B. Form: Prepare submittal schedule in chronological sequence of submittals. Show category of submittal, name of subcontractor, generic description of work covered, related section numbers, activity or event number on progress schedule, scheduled date for first submission and blank columns for actual date of submittal, resubmittal and final release or approval by Architect or Engineer.

1.5 PROGRESS MEETING, REPORTING:

A. General: In addition to specific coordination meetings for each element of work and other regular project meetings for other purposes, Contractor shall attend general progress meeting each month, with time coordinated with preparation of payment requests. Require each subcontractor and each other entity then involved in planning, coordination or performance of work to be properly represented at each meeting. Review each entity's present and future needs including interface requirements, time, sequences, deliveries, access, site utilization, temporary facilities and services, hours of work, hazards and risks, housekeeping, change orders and documentation of information for payment requests. Discuss whether each element of current work is ahead of schedule,

on time or behind time in relation with integrated and updated progress schedule. Determine how behind time work will be expedited and secure commitments from each prime contractor and other major entities involved in doing so. Discuss whether schedule revisions are required to ensure that current work and subsequent work will be completed within Contract Time of each prime contract. Review everything of significance which could affect progress of the work.

1. Initial Progress Meeting: Schedule initial progress meeting, recognized as "Preconstruction Meeting," for a date not more than 7 days after date of commencement of the work. Conduct this meeting as an organizational meeting and review responsibilities and personnel assignments.
2. Reporting: Within 3 days after each progress meeting date, Architect will distribute copies of minutes of the meeting to each entity present and to others who should have been present. Include a brief summary (in narrative form) of progress of the work since previous meeting and report.
3. Schedule Updating: Immediately following each progress meeting, where revisions to progress schedule have been made or recognized, Contractor shall revise the integrated progress schedule. Reissue revised schedule concurrently with report of each meeting.

B. Daily Reports: Contractor shall prepare a daily report, recording the following information concerning events at the site; and shall submit duplicate copies to Architect or Engineer at regular intervals not exceeding weekly intervals.

1. List of subcontractors at the site.
2. Approximate total count of personnel at the site.
3. High/low temperatures, general weather conditions.
4. Accidents (refer to accident reports).
5. Meetings and significant decisions.
6. Unusual events (refer to special reports).
7. Stoppages, delays, shortages, losses.
8. Meter readings and similar recordings.
9. Emergency procedures, field orders.
10. Orders/requests by governing authorities.
11. Change orders received, implemented.
12. Services connected, disconnected.
13. Equipment or system tests and start-ups.
14. Partial completions, occupancies.
15. Substantial completions authorized.

1.6 SCHEDULE OF VALUES:

A. General: Contractor shall prepare a schedule of values, as required by General Conditions, in coordination with the preparation of progress schedule. Correlate line items with other administrative schedules and forms required for the work, including progress schedule, payment request form, listing of subcontractors, schedule of allowances, schedule of alternates, listing of products and principal suppliers and fabricators and schedule of submittals. Provide breakdown of Contract Sum in sufficient detail to facilitate continued evaluation of payment requests and progress reports. Breakdown principal subcontract amounts into several line items. Round off to nearest whole dollar, but with total equal to Contract Sum. Submit 3 copies of each schedule of values to Architect/Engineer.

1. Subschedules: Where work is separated into phases which require separately phased payments to prime Contractor, provide subschedules showing values correlated with each phase of payment.

2. Material/Fabrication Values: For each unit of work where payment requests will be made on account of materials or equipment purchased/fabricated/delivered but not yet installed, show "initial value" for payment request and "value added" for subsequent stage or stages of completion on that unit of work.
3. Unit Cost Allowances: Show line item value as product of unit cost x measured quantity as estimated from best indication in contract documents.
4. Time Coordination: In coordination of initial submittals and other administrative "start-up" activities, submit schedule of values to Architect/Engineer at earliest feasible date, but in no case later than 7 days before initial payment request is to be submitted.
5. Listing: Arrange schedule with columns to indicate generic name of item, related specification sections, subcontractor, supplier/manufacturer/fabricator, change orders (numbers) which have affected value, dollar value of item and percentage of Contract Sum (to nearest one hundredth percent and adjusted to total 100 percent).
6. Margins of Cost: Show line items of indirect costs and margins on actual costs, only to extent such items will be individually listed in payment requests. In general, establish each item in schedule of values (and in payment requests) to be complete with its total expenses and proportionate share of general overhead and profit margin. Except as otherwise indicated, major cost items, which are not directly cost of actual work in place, such as distinct temporary facilities, may be either shown as line items in schedule of values or distributed as general overhead expense, at Contractor's option.
7. Schedule Updating: Update and resubmit schedule of values when change orders affect listing and when actual performance of the work involves necessary changes of substance to values previously listed.

1.7 PAYMENT REQUESTS:

A. General: Except as otherwise indicated, sequence of progress payments for Contractor is to be regular and each must be consistent with previous applications and payments. It is recognized that certain applications involve extra requirements, including initial applications, applications at times of substantial completion and final payment applications.

1. Payment Application Times: The "date for each progress payment" for Contractor is as indicated in Owner-Contractor Agreement. The period of construction work covered by each payment request is period indicated in Owner-Contractor Agreement.
2. Payment Application Forms: AIA Document G702 and Continuation Sheets; available from Publications Distribution Div., The American Institute of Architect, 1735 New York Ave., N.W., Washington, DC 20006 (also available at most local AIA chapter offices). Any other forms must be submitted to the Architect prior to its use.
3. Application Preparation: Except as otherwise indicated, complete every entry provided for on the form, including notarization and execution by authorized persons. Incomplete applications will be returned by Architect/Engineer without action. Entries must match current data of schedule of values, progress schedule and reports. Listing must include amounts of change orders issued prior to first day of the "period of construction" covered by application.
4. Initial Payment Application: The principal administrative actions and submittals which must precede or coincide with submittal of Contractors first payment application can be summarized as follows, but not necessarily by way of limitation:

a. Listing of subcontractors and principal suppliers and fabricators (as

previously submitted) with contact person, address and telephone number.

b. Schedule of values.
c. Progress schedule (preliminary if not final).
d. Schedule of submittals (preliminary if not final).
e. Listing of Contractor's staff assignments and principal consultants.
f. Copies of acquired building permits and similar authorizations and licenses from governing authorities for current performance of the work.
g. Performance and/or payment bonds (if required).
h. Evidence satisfactory to Owner that Contractor's insurance coverages have been secured.
i. Data needed by Owner to secure related insurance coverages.

5. Application at Time of Substantial Completion: Following issuance of Architect/Engineer's final "certificate of substantial completion" on Contractors work and also in part as applicable to prior certificates on portions of completed work as designated, a "special" payment application may be prepared and submitted by Contractor. The principal administrative actions and submittals which must proceed or coincide with such special applications can be summarized as follows, but not necessarily by way of limitation:

a. Occupancy permits and similar approvals or certifications by governing authorities and franchised services, assuring Owner's full access and use of completed work.
b. Warranties, guarantees, maintenance agreements and similar provisions of contract documents.
c. Test/adjust/balance records, maintenance instructions, meter readings, start-up performance reports and similar change over information germane to Owner's occupancy, use, operation and maintenance of completed work.
d. Final cleaning of the work.
e. Application for reduction (if any) of retainage and consent of surety.
f. Advice to Owner on coordination of shifting insurance coverages, including proof of extended coverages as required.
g. Listing of Contractor's incomplete work recognized as exceptions to Architect/Engineer's certificate of substantial completion.

6. Final Payment Application: The administrative actions and submittals which must precede or coincide with submittal of Contractor's final payment application can be summarized as follows, but not necessarily by way of limitation:

a. Completion of project closeout requirements.
b. Completion of items specified for completion beyond time of substantial completion (regardless of whether special payment application was previously made).
c. Assurance satisfactory to Owner that unsettled claims will be settled and that work not actually completed and accepted will be completed without undue delay.
d. Transmittal of required project construction records to Owner.
e. Removal of temporary facilities, services, surplus materials, rubbish and similar elements.
f. Change over of door locks and other provisions for Contractor's access to Owner's property.

7. Application Transmittal: Contractor shall submit 3 executed copies of each payment application, one copy of which shall be complete with waivers of lien.

and similar attachments. Transmit each copy with a transmittal form listing those attachments and recording appropriate information related to application in a manner acceptable to Architect/Engineer. Transmit to Architect/Engineer by means ensuring receipt within 24 hours.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

Not Applicable

END SECTION 01 32 00

SECTION 01 33 00 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. The types of submittal requirements specified in this section include shop drawings, product data, samples and miscellaneous work related submittals. Individual submittal requirements are specified in applicable sections for each unit of work. Refer to other Division 1 sections and other contract documents for requirements of administrative submittals.

B. Definitions: Work related submittals of this section are categorized for convenience as follows:

1. Shop drawings include specially prepared technical data for this project; including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form for general application to several projects.
2. Product data include standard printed information on materials, products and systems; not specially prepared for this project, other than the designation of selections from among available choices printed therein.
3. Samples include both fabricated and unfabricated physical examples of materials, products and units of work; both as complete units and as smaller portions of units of work; either for limited visual inspection or (where indicated) for more detailed testing and analysis.
4. Mock-ups are a special form of samples, which are too large or otherwise inconvenient for handling in specified manner for transmittal of sample submittals.
5. Miscellaneous submittals related directly to the work (nonadministrative) include warranties, maintenance agreements, workmanship bonds, project photographs, survey data and reports, physical work records, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, operating and maintenance materials, overrun stock and similar information, devices and materials applicable to the work and not processed as shop drawings, product data or samples.

1.3 GENERAL SUBMITTAL REQUIREMENTS:

A. Scheduling: Where appropriate in required administrative submittals (listing of products, manufacturers, suppliers and subcontractors and in job progress schedule), show principal work related submittals and time schedules for coordination of submittal activity with related work in each instance.

B. Coordination and Sequencing: Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittals. Coordinate and

sequence different categories of submittals for same work and for interfacing units of work, so that one will not be delayed for coordination with another.

C. Submittal Types; Paper and Electronic:

1. Submittals may be sent in paper form, or electronic form.
2. Submittals which are received from sources other than through Contractor's office will be returned "without action."
3. Accompany submittal with Transmittal Form as specified below.
4. Paper Document Requirements:

a. Preparation of Submittals: Provide permanent marking on each submittal to identify project, date, Contractor, subcontractor, submittal name and similar information to distinguish it from other submittals. Show Contractor's executed review and approval marking and provide space for Architect/Engineer's "Action" marking. Package each submittal appropriately for transmittal and handling.

5. Electronic Document Requirements:

a. Submit an individual file for each submittal item in Acrobat ".pdf" document format.
b. Preparation of Submittals: Provide permanent marking on each submittal to identify project, date, Contractor, subcontractor, submittal name and similar information to distinguish it from other submittals. Show Contractor's executed review and approval marking and provide space for Architect/Engineer's "Action" marking.
c. Specific marking may be done on each submittal page of the document file in contrasting color:

1) Red color marking is reserved for Architect and Architect's consultants only.

d. At the Contractor's option, a cover page (not to be construed as the Transmittal Form) with the required information and written commentary may be provided on the condition that it is integral to the individual file being submitted.

D. Transmittal Form: Provide the following information on the transmittal form:

Date.
General contractors name address and telephone number.
Name of related subcontractor and supplier.
Submittal description.
Number of copies submitted.
Specification section title and number.
Other questions or comments related to the submittal.

1.4 SPECIFIC-CATEGORY SUBMITTAL REQUIREMENTS:

A. General: Except as otherwise indicated in individual work sections, comply with requirements specified herein for each indicated category of submittal.

B. Shop Drawings: Provide newly prepared information, on reproducible sheets, with graphic information at accurate scale (except as otherwise indicated), with name of preparer indicated (firm name). Show dimensions and note which are based on field

measurement. Identify materials and products in the work shown. Indicate compliance with standards and special coordination requirements. Do not allow shop drawing copies without appropriate final "Action" markings by Architect/Engineer to be used in connection with the work.

1. Each Submittal: The contractor shall submit three sets for the A/E, four sets for Contractor and as many additional sets as they may need (including any sets for maintenance manuals). All submittals shall have contractor's approval stamp on them before A/E review. Sets to structural and electrical consultants shall be sent directly to them with copy of transmittal sent to the A/E's Office. Include specification section number of the transmittal. One blueline and one reproducible should be submitted if the submitter feels there will be many changes made to the submittal by the A/E (i.e., structural steel).

C. Product Data: Collect required data into one submittal for each unit of work or system; and mark each copy to show which choices and options are applicable to project. Include manufacturer's standard printed recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements which have been checked and special coordination requirements. Maintain one set of product data (for each submittal) at project site, available for reference by Architect/Engineer and others.

1. Submittals: Do not submit product data or allow its use on the project until compliance with requirements of contract documents has been confirmed by Contractor. Submittal is for information and record, unless otherwise indicated. Initial submittal is final submittal unless returned promptly by Architect/Engineer, marked with an "Action" which indicates an observed noncompliance. Submit 3 copies for A/E and Owner use, plus number required for contractor's use, including O&M Manuals.

   Provide a preliminary single copy submittal where required (or desired by Contractor) for selection of options by Architect/Engineer.
2. Installer's Copy: Do not proceed with installation of materials, products or systems until final copy of applicable product data is in possession of Installer.

D. Samples: Provide units identical with final condition of proposed materials or products for the work. Include "range" samples (not less than 3 units) where unavoidable variations must be expected and describe or identify variations between units of each set. Provide full set of optional samples where Architect/Engineer's selection is required. Prepare samples to match Architect/Engineer's sample where so indicated. Include information with each sample to show generic description, source or product name and manufacturer, limitations and compliance with standards. Samples are submitted for review and confirmation of color, pattern, texture and "kind" by Architect/Engineer. Architect/Engineer will not "test" samples (except as otherwise indicated) for compliance with other requirements, which are therefore the exclusive responsibility of the Contractor.

1. Submittal: At Contractor's option, provide preliminary submittal of a single set of samples for Architect/Engineer's review and "Action." Otherwise initial submittal is final submittal unless returned with "Action" which requires resubmittal. Submit 3 sets of samples in final submittal; one set will be returned.
2. Quality Control Set: Maintain returned final set of samples at project site in suitable condition and available for quality control comparisons by Architect/Engineer and by others.

3. Reusable Samples: Returned samples which are intended or permitted to be incorporated in the work are so indicated in the individual work sections and must be in undamaged condition at time of use.

E. Mock-Ups: Where mock-ups and similar samples are indicated in individual work sections recognized as a special type of sample, comply with requirements for "samples" to greatest extent possible and process transmittal forms to provide a record of activity.

F. Inspection and Test Reports: Classify each as either "shop drawing" or "product data" depending upon whether report is uniquely prepared for project or a standard publication of workmanship control testing at point of production and process accordingly.

G. Warranties: Refer to "Products" section for specific general requirements on warranties, product/workmanship bonds and maintenance agreements. In addition to copies desired for Contractor's use, furnish 2 executed copies, except furnish 2 additional (conformed) copies where required for maintenance manuals.

H. Survey Data: Refer to "Procedures" section for specific general requirements on property surveys, field measurements, quantitative records of actual work, damage surveys, photographs and similar data required by individual work sections of these specifications. None of specified copies will be returned.

1. Survey Copies: Furnish 3 copies of survey data.
2. Records of Actual Work: Furnish copies as specified in closeout sections.
3. Project Photographs: Furnish 2 prints plus negatives.

I. Standards: Where copy submittal is indicated, and except where specified integrally with "Product Data" submittal, submit a single copy for Architect/Engineer's use. Where workmanship at project site and elsewhere is governed by standard, furnish additional copies to fabricators, installers and others involved in performance of the work.

J. Closeout Submittals: Refer to "closeout" sections for specific general requirements on submittal of closeout information, materials, tools and similar items.

1. As Built Copies: Furnish one set.
2. Maintenance/Operating Manuals: Furnish 2 bound copies in 3-ring binders and provide 2 complete sets in ".pdf" format on Compact Disks.
3. Materials and Tools: Refer to individual work sections for required quantities of spare parts, extra and overrun stock, maintenance tools and devices, keys and similar physical units to be submitted.

K. General Distribution: Provide additional distribution of submittals (not included in foregoing copy submittal requirements) to subcontractors, suppliers, fabricators, installers, governing authorities and others as necessary for proper performance of the work. Include such additional copies in transmittal to Architect/Engineer where required to receive "Action" marking before final distribution. Show such distributions on transmittal forms.

1.5 ACTION ON SUBMITTALS:

A. Architect/Engineer's Action: Where action and return is required or requested, Architect/Engineer will review each submittal and where possible return within 2 weeks of receipt. Where submittal must be held for coordination, Contractor will be so advised without delay.

1. Final Unrestricted Release: Work may proceed, provided it complies with contract documents, when submittal is returned with the following:

   Marking: "Reviewed."

2. Final But Restricted Release: Work may proceed, provided it complies with notations and corrections on submittal and with contract documents, when submittal is returned with the following:

   Marking: "Reviewed (with comments)."

3. Returned for Resubmittal: Do not proceed with work. Revise submittal in accordance with notations thereon and resubmit without delay to obtain a different action marking. Do not allow submittals with the following marking (or unmarked submittals where a marking is required) to be used in connection with performance of the work:

   Marking: "Rejected (resubmit)."

4. Action Stamp: Architect/Engineer's action stamp, for use on submittals to be returned to Contractor, is self-explanatory as marked.

PART 2 - PRODUCTS

Not applicable

PART 3 - EXECUTION

Not applicable

END SECTION 01 33 00

SECTION 01 42 00 - DEFINITIONS AND STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DEFINITIONS:

A. General Explanation: A substantial amount of specification language constitutes definitions for terms found in other contract documents, including the drawings which must be recognized as diagrammatic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in the contract documents are defined generally in this article. Definitions and explanations of this section are not necessarily either complete or exclusive, but are general for the work to extent not stated more explicitly in another provision of the contract documents.

B. "General Requirements": The provisions or requirements of Division 1 sections. General Requirements apply to entire work of Contract and, where so indicated, to other elements of work which are included in the project.

C. "Indicated": The term "Indicated" is a cross-reference to details, notes or schedules on the drawings, to other paragraphs or schedules in the specifications and to similar means of recording requirements in the contract documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for purpose of helping reader locate cross-reference and no limitation of location is intended except as specifically noted.

D. "Directed, Requested, Etc.": Where not otherwise explained, terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted" and "permitted" mean "directed by Architect/Engineer," "requested by Architect/Engineer," etc. However, no such implied meaning will be interpreted to extend Architect/Engineer's responsibility into Contractor's area of construction supervision.

E. "Approve": Where used in conjunction with Architect/Engineer's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term "approved" will be held to limitations of Architect/Engineer's responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by Architect/Engineer be interpreted as a release of Contractor from responsibilities to fulfill requirements of the contract documents.

F. "Project Site": The space available to Contractor for performance of the work, either exclusively or in conjunction with others performing other work as part of the project. The extent of project site is shown on the drawings and may or may not be identical with description of the land upon which project is to be built.

G. "Furnish": Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to project site ready for unloading, unpacking, assembly, installation,

etc., as applicable in each instance.

H. "Install": Except as otherwise defined in greater detail, term "install" is used to describe operations at project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing protecting, cleaning and similar operations, as applicable in each instance.

I. "Provide": Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

J. "Installer": The entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for the performance of a particular unit of work at the project site, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.

K. "Testing Agencies": An independent entity engaged to perform specific inspections or tests of the work, either at project site or elsewhere; and to report and (if required) interpret results of those inspections or tests.

L. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

1.3 FORMAT AND SPECIFICATION EXPLANATIONS:

A. Specification Production: None of these explanations will be interpreted to modify substance of requirements. Portions of these specifications have been produced by Architect/Engineer's standard methods of editing master specifications and may contain minor deviations from traditional writing formats. Such deviations are a normal result of this production technique and no other meaning will be implied or permitted.

B. Format Explanation: The format of principal portions of these specifications can be described as follows; although other portions may not fully comply and no particular significance will be attached to such compliance or noncompliances:

1. Sections and Divisions: For convenience, basic unit of specification text is a "section" each unit of which is named and numbered. These are organized into related families of sections and various families of sections are organized into "divisions" which are recognized as the present industry consensus on uniform organization and sequencing of specifications. The section title is not intended to limit meaning or content of section nor to be fully descriptive of requirements specified therein nor to be an integral part of text.
2. Each section of specifications has been subdivided into 3 (or less) "parts" for uniformity and convenience (Part 1 - General, Part 2 - Products and Part 3 - Execution). These do not limit the meaning of and are not an integral part of text which specifies requirements.

C. Imperative Language: Used generally in specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities which must be fulfilled indirectly by Contractor or when so noted by others.

D. Section Numbering: Used to facilitate cross-references in contract documents. Sections are placed in Project Manual in numeric sequence; however, numbering sequence is not complete, and listing of sections at beginning of Project Manual must be consulted to

determine numbers and names of specification sections in the contract documents.

E. Page Numbering: Numbered independently for each section; recorded in listing of sections (Index or Table of Contents) in Project Manual. Section number is shown with page number at bottom of each page, to facilitate location of text in Project Manual.

F. Specification Content: Because of methods by which this project specification has been produced, certain general characteristics of content and conventions in use of language are explained as follows:

1. Specifying Methods: The techniques or methods of specifying to record requirements varies throughout text and may include "prescriptive," "open generic-descriptive," "compliance with standards," "performance," "proprietary" or a combination of these. The method used for specifying one unit of work has no bearing on requirements for another unit of work.
2. Overlapping and Conflicting Requirements: Where compliance with 2 or more industry standards or sets of requirements is specified and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, most stringent requirement (which is generally recognized to be also most costly) is intended and will be enforced, unless specifically detailed language written into the contract documents (not by way of reference to an industry standard) clearly indicates that a less stringent requirement is to be fulfilled. Refer apparently equal but different requirements and uncertainties as to which level of quality is more stringent to Architect/Engineer for a decision before proceeding.
3. Contractor's Options: Except for overlapping or conflicting requirements, where more than one set of requirements are specified for a particular unit of work, option is intended to be Contractor's regardless of whether specifically indicated as such.
4. Minimum Quality/Quantity: In every instance, quality level or quantity shown or specified is intended as minimum for the work to be performed or provided. Except as otherwise specifically indicated, actual work may either comply exactly with that minimum (within specified tolerances) or may exceed that minimum within reasonable limits. In complying with requirements, indicated numeric values are either minimums or maximums as noted or as appropriate for context of requirements. Refer instances of uncertainty to Architect/Engineer for decision before proceeding.
5. Specialists; Assignments: In certain instances, specification text requires (or at least implies) that specific work be assigned to specialists or expert entities, who must be engaged for performance of those units of work. These must be recognized as special requirements over which Contractor has no choice or option. These assignments must not be confused with (and are not intended to interfere with) normal application of regulations, union jurisdictions and similar conventions. One purpose of such assignments is to establish which party or entity involved in a specific unit of work is recognized as "expert" for indicated construction processes or operations. Nevertheless, final responsibility for fulfillment of entire set of requirements remains with Contractor.
6. Trades: Except as otherwise indicted, the use of titles such as "carpentry" in specification text, implies neither that the work must be performed by an accredited or unionized tradesman of the corresponding generic name (such as "carpenter"), nor that specified requirements apply exclusively to work by tradesmen of that corresponding generic name.
7. Abbreviations: The language of specifications and other contract documents is of the abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in the text. Specific abbreviations have been

established, principally for lengthy technical terminology and primarily in conjunction with coordination of specification requirements with notations on drawings and in schedules. These are frequently defined in section at first instance of use. Trade association names and titles of general standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the contract documents so indicates.

1.4 DRAWING SYMBOLS:

A. General: Except as otherwise indicated, graphic symbols used on drawings are those symbols recognized in the construction industry for purposes indicated. Where not otherwise noted, symbols are defined by "Architectural Graphic Standards," published by John Wiley & Sons, Inc., latest edition.

1.5 INDUSTRY STANDARDS:

A. General Applicability of Standards: Applicable standards of construction industry have same force and effect (and are made a part of contract documents by reference) as if copied directly into contract documents or as if published copies were bound herewith.

1. Reference standards (referenced directly in contract documents or by governing regulations) have precedence over nonreferenced standards which are recognized in industry for applicability to work.
2. Nonreferenced standards are hereby defined to have no particular applicability to the work, except as a general measurement of whether work complies with standards recognized in construction industry.

B. Publication Dates: Except as otherwise indicated, where compliance with an industry standard is required, comply with standard in effect as of date of contract documents.

C. Copies of Standards: Provide where needed for proper performance of the work; obtain directly from publication sources.

D. Abbreviations and Names: Where acronyms or abbreviations are used in specifications or other contract documents, they are defined to mean the industry recognized name of trade association, standards generating organization, governing authority or other entity applicable to context of text provision. Refer to "Encyclopedia of Associations," published by Gale Research Co., available in large libraries.

E. Abbreviations and Names: The following acronyms or abbreviations as referenced in contract documents are defined to mean the associated names. Both names and addresses are subject to change, and are believed to be, but are not assured to be, accurate and up to date as of date of contract documents:

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
FS	Federal Specification Available from Department of Defense Single Stock Point www.dodssp.daps.mil	(215) 697-6257
	Available from General Services Administration	(202) 501-1021

	www.fss.gsa.gov	
FTMS	Federal Test Method Standard (See FS)	
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543

1.1 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 indicated in Gale Research's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

B. 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-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The) www.aluminum.org	(202) 862-5100
AAADM	American Association of Automatic Door Manufacturers www.aaadm.com	(216) 241-7333
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists (The) www.aatcc.org	(919) 549-8141
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	ACI International (American Concrete Institute) www.aci-int.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700

AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AHA	American Hardboard Association (Now part of CPA)	
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALCA	Associated Landscape Contractors of America www.alca.org	(800) 395-2522 (703) 736-9666
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts www.aosaseed.com	(505) 522-1437
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917

ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (The American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (212) 591-7722
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9585
AWCI	AWCI International (Association of the Wall and Ceiling Industries International) www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (Now WCSC)	
AWI	Architectural Woodwork Institute www.awinet.org	(800) 449-8811 (703) 733-0600
AWPA	American Wood-Preservers' Association www.awpa.com	(334) 874-9800
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BICSI	BICSI www.bicsi.org	(813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(773) 761-4100
	Cast Stone Institute	(770) 972-3011

	www.caststone.org	
CCC	Carpet Cushion Council www.carpetcushion.org	(203) 637-1312
CDA	Copper Development Association Inc. www.copper.org	(800) 232-3282 (212) 251-7200
CEA	Canadian Electricity Association www.canelect.ca/connections_online/home.htm	(613) 230-9263
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CGSB	Canadian General Standards Board w3.pwgsc.gc.ca/cgsb	(800) 665-2472 (819) 956-0425
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CPA	Composite Panel Association www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association www.cppa-info.org	(800) 510-2772 (202) 462-9607
CRI	Carpet & Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(800) 463-6727 (416) 747-4000
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 820-7700
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)	(281) 583-4087

	www.cti.org	
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945
EJCDC	Engineers Joint Contract Documents Committee www.asce.org	(800) 548-2723 (703) 295-6300
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association www.esda.org	(315) 339-6937
FCI	Fluid Controls Institute www.fluidcontrolsinstitute.org	(216) 241-7333
FIBA	Federation Internationale de Basketball Amateur (The International Basketball Federation) www.fiba.com	41 22 545 00 00
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation) www.fivb.ch	41 21 345 35 35
FM	Factory Mutual System (Now FMG)	
FMG	FM Global (Formerly: FM - Factory Mutual System) www.fmglobal.com	(401) 275-3000
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridaroof.com	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	52 951 5146905
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GS	Green Seal www.greenseal.org	(202) 872-6400

GSI	Geosynthetic Institute www.geosynthetic-institute.org	(610) 522-8440
HI	Hydraulic Institute www.pumps.org	(888) 786-7744 (973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAS	International Approval Services (Now CSA International)	
IBF	International Badminton Federation www.intbadfed.org	441-24 223-4904
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance (The) www.igmaonline.org	(613) 233-1510
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(702) 567-8150
ITS	Intertek	(800) 345-3851

	www.intertek.com	(607) 753-6711
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LMA	Laminating Materials Association (Now part of CPA)	
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864 (847) 577-7200
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Maple Flooring Manufacturers Association www.maplefloor.org	(847) 480-9138
MFMA	Metal Framing Manufacturers Association www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(312) 332-0405
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926
NAIMA	North American Insulation Manufacturers Association (The) www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCAA	National Collegiate Athletic Association (The)	(317) 917-6222

	www.ncaa.org	
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-3550
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(303) 697-8441
NFHS	National Federation of State High School Associations www.nfhs.org	(317) 972-6900
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	National Oak Flooring Manufacturers Association www.nofma.org	(901) 526-5016
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International)	(800) 673-6275 (734) 769-8010

	www.nsf.org	
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. www.ntma.com	(800) 323-9736 (540) 751-0930
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)	
NWWDA	National Wood Window and Door Association (Now WDMA)	
OPL	Omega Point Laboratories, Inc. www.opl.com	(800) 966-5253 (210) 635-8100
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDCA	Painting & Decorating Contractors of America www.pdca.com	(800) 332-7322 (314) 514-7322
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
PGI	PVC Geomembrane Institute http://pgi-tp.ce.uiuc.edu	(217) 333-3929
PTI	Post-Tensioning Institute www.post-tensioning.org	(602) 870-7540
RCSC	Research Council on Structural Connections www.boltcouncil.org	(800) 644-2400 (312) 670-2400
RFCI	Resilient Floor Covering Institute www.rfci.com	(301) 340-8580
RIS	Redwood Inspection Service www.calredwood.org	(888) 225-7339 (415) 382-0662
RTI	(Formerly: NTRMA - National Tile Roofing Manufacturers Association) (Now TRI)	
SAE	SAE International www.sae.org	(724) 776-4841
SDI	Steel Deck Institute www.sdi.org	(847) 462-1930
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(516) 294-5424

SEI	Structural Engineering Institute www.seinstitute.com	(800) 548-2723 (703) 295-6195
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 646-2234
SIA	Security Industry Association www.siaonline.org	(703) 683-2075
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)	
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association www.smacentral.org	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SMPTE	Society of Motion Picture and Television Engineers www.smpte.org	(914) 761-1100
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division) www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SPI/ SPFD	Society of the Plastics Industry, Inc. (The) Spray Polyurethane Foam Division (Now SPFA)	
SPRI	SPRI (Single Ply Roofing Institute) www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974

TCA	Tile Council of America, Inc. www.tileusa.com	(864) 646-8453
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute, Inc. www.tpinst.org	(608) 833-5900
TPI	Turfgrass Producers International www.turfgrasssod.org	(800) 405-8873 (847) 705-9898
TRI	Tile Roofing Institute (Formerly: RTI - Roof Tile Institute) www.tileroofing.org	(312) 670-4177
UL	Underwriters Laboratories Inc. www.ul.com	(800) 285-4476 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USAV	USA Volleyball www.usavolleyball.org	(888) 786-5539 (719) 228-6800
USGBC	U.S. Green Building Council www.usgbc.org	(202) 828-7422
USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association) www.windowcoverings.org	(800) 506-4636 (212) 661-4261
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) www.wicnet.org	(916) 372-9943
WIC	Woodwork Institute of California (Now WI)	

WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 548-0112
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

1.6 CODE AGENCIES:

A. 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-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

BOCA	BOCA International, Inc. (See ICC)	
CABO	Council of American Building Officials (See ICC)	
IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICBO	International Conference of Building Officials (See ICC)	
ICBO ES	ICBO Evaluation Service, Inc. (See ICC-ES)	
ICC	International Code Council (Formerly: CABO - Council of American Building Officials) www.iccsafe.org	(703) 931-4533
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
SBCCI	Southern Building Code Congress International, Inc., (See ICC)	

1.7 GOVERNING REGULATIONS/AUTHORITIES:

A. General: The procedure followed by the Architect/Engineer has been to contact governing authorities where necessary to obtain information needed for the purpose of preparing the contract documents; recognizing that such information may or may not be of significance in relation to the Contractor's responsibilities for performing the work. Contact governing authorities directly for necessary information and decision having a bearing on the performance of the work.

1.8 SUBMITTALS:

A. Permits, Licenses and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon

performance of the work.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

Not Applicable

END SECTION 01 42 00

SECTION 01 50 00 - TEMPORARY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. Definitions: Specific administrative and procedural minimum actions are specified in this section, as extensions of provisions in General Conditions and other contract documents. These requirements have been included for special purposes as indicated. Nothing in this section is intended to limit types and amounts of temporary work required and no omission from this section will be recognized as an indication by Architect that such temporary activity is not required for successful completion of the work and compliance with requirements of contract documents. Provisions of this section are applicable to, but not by way of limitation, utility services, construction facilities, support facilities and security/protection provisions.

B. General Division of Responsibilities: Contractor is specifically assigned certain responsibilities for temporary facilities to be used by all subcontractors, other contractors/separate entities at the site, the Owner's work forces and other personnel including occupants of the project, the Architect, personnel of governing authorities and similar entities and personnel authorized to be at the project site during the contract time span of the contracts.

C. Except as otherwise specifically indicated in contract documents, no costs or usage charges for temporary facilities are chargeable to the Owner, Architect; nor can any contractor's cost or usage charges for temporary facilities be accepted as the basis for a change order extra. Except as otherwise indicated, the total costs and usage charges for temporary facilities are included, collectively, in the Contract Amounts of the contract.

1.3 QUALITY ASSURANCE:

A. General: In addition to compliance with governing regulations and rules/recommendations of franchised utility companies, Contractor shall comply with specific requirements indicated and with applicable local industry standards for construction work (published recommendations by local "building councils").

B. ANSI Standards: Contractor shall comply with applicable provisions of ANSI A10 Series Standards on construction safety, including A10.3, A10.4, A10.5, A10.6, A10.7, A10.8, A10.9, A10.10, A10.11, A10.12, A10.13, A10.14, A10.15, A10.17, A10.18, A10.20, and A10.22.

C. NFPA Code: Contractor shall comply with NFPA Code 241 "Building Construction and Demolition Operations."

D. Conservation: Consistent with conscientious practice regarding energy/materials conservation, Contractor shall install and operate temporary facilities and perform construction activities in manner which reasonably will be conservative and avoid waste

of energy and materials including water and fuels.

1.4 JOB CONDITIONS:

A. General: Contractor shall establish and initiate use of each temporary facility at time first reasonably required for proper performance of the total work of project. Terminate use and remove facilities at earliest reasonable time, when no longer needed or when permanent facilities have, with authorized use, replaced the need.

B. Conditions of Use: Contractor shall install, operate, maintain and protect temporary facilities in a manner and at locations which will be safe, nonhazardous, sanitary and protective of persons and property and free of deleterious effects.

PART 2 PRODUCTS

2.1 EQUIPMENT:

A. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction.
2. Cleaning of duct system and equipment may be mandated if contamination is found in system prior to "Substantial Completion."

PART 3 - EXECUTION

3.1 TEMPORARY UTILITY SERVICES:

A. General: Where possible and reasonable, connect to existing franchised utilities for required services and comply with service companies' recommendations on materials and methods or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations. The types of services required include, but not by way of limitation the following and each is to be provided by the Contractor as indicated:

1. Telephone Service, provided by Contractor.
2. Surface drainage provisions, by Contractor.
3. Piped water and sewerage, by Contractor (Plumbing and Sewer subcontractor).
4. Electrical power, by Contractor (Electrical subcontractor).

B. Potable Water Connection: Water connection (without charge) to Owner's existing potable water system is limited to one, 3/4 inch pipe size connection and maximum flow of 10 gpm.

C. Sewer Sediment: Prior to start of work at project site, subcontractor for Plumbing and Gas Piping shall engage an independent sewer inspection service to measure existing levels of sediment in sewers and to provide recommendations for minimizing entrance of sediment and polluting substances during construction. At time of substantial completion on elements of work affecting inflow of sewage, check sediment levels and submit report recording changes in condition of sediment in existing sewers. Clean sewers where level has increased significantly, as judged by Architect or as reasonably demanded by

sewerage authority. Maintain sewers and temporary connecting sewers in a reasonably clean, nonclogged condition during construction period.

D. Temporary Power: Subcontractor for Electrical Work shall provide service with ground fault circuit interrupter feature, activated from each circuit of 20 amp or less rating, all from existing service, panels and outlets.

3.2 TEMPORARY CONSTRUCTION FACILITIES:

A. General: The types of temporary construction facilities required include, but not by way of limitation, water distribution, drainage, dewatering equipment, enclosure of work, heat, ventilation, electrical power distribution, lighting, hoisting facilities, stairs, ladders and roads. Provide facilities reasonably required to perform construction operations properly and adequately.

B. Work Assigned to Plumbing Subcontractor:

1. Water Distribution: As soon as practical after start of work at project site and as required for construction, provide temporary water distribution piping system, with 3/4 inch hose-bib terminations at construction work, located so that any area of building construction can be reached with a 100 foot length of hose. Provide hose units and protect system from freezing. Maintain system in operation at all locations until either the need for water has ended or the permanent system is placed in use for temporary water service. Maintain minimum water pressure of 30 psig at each hose bib, with 5 gpm flow rate.

   a. Where potable water is available, either for total temporary requirements or as a separate service for drinking water, extend piping system through construction areas.
   b. Where nonpotable water is used, mark each outlet with adequate health hazard warning signs, including nozzle end of each hose.
   c. As permanent water distribution system is accepted as substantially complete, either entire system or usable portions thereof, make suitable provisions for temporary use thereof and remove unused portions of temporary system. Maintain and operate permanent water distribution system until time of final acceptance and transfer of operation to Owner's personnel.

2. Piped Drainage: Provide temporary piped drainage system to whatever extent surface drainage cannot be utilized to dispose of waste water from construction operations, storm water and sanitary sewage, including sanitary drainage from temporary offices if any.

   a. Provide temporary pumps and similar equipment as necessary for adequate drainage from temporary drainage systems. Refer to "Excavating" sections of specifications for dewatering of excavations, which is not specified as work of this section.
   b. As permanent drainage systems are accepted as substantially complete, either entire systems or usable portions thereof, make suitable provisions for temporary use thereof and remove unused portions of temporary systems. Maintain and operate permanent waste/drainage/vent systems including pumping equipment until time of final acceptance and transfer of operations to Owner's personnel.

C. Work Assigned to Subcontractor for Electrical Work:

1. Electrical Power Distribution: As soon as practical after start of work at project site provide temporary electrical power distribution system sufficient to accommodate temporary lighting and construction operations including the use of power tools (but not including heavy-duty electrical welding units), incidental electrical heating units and start-up of specified building equipment which must be tested, started or placed into use prior to completion of its permanent power connections. Provide weatherproof, grounded wiring with overload protection; with direct wired connections where feasible and for voltages over 220/208 volts. Provide plug-in outlet stations at each story of construction sufficient to reach any area of building construction with a 100-foot long extension cord. Extend temporary power to designated on-site fabrication areas, to temporary offices and sanitation facilities and to similar on-site locations where the temporary use of electrical power is indicated.

   a. Temporary power requirements, in addition to power for hand tools and lighting, are recognized to include, but not by way of limitation, power for pumps, fans, blowers, heaters, tower cranes, elevators, special hoists, air compressors, pipe threaders, chillers and similar construction equipment. Refer to technical work section of specifications where combustion engine driven equipment or power generating units may be required (not as work of this section) to satisfy other construction work energy requirements.
   b. As permanent power distribution system is accepted as substantially complete, either entire system or usable portions thereof, make suitable provisions for temporary use thereof and remove unused portions of temporary system. Maintain and operate permanent electrical supply and distribution system until time of final acceptance and transfer of operation to Owner's personnel.

2. Lighting: As soon as practical after excavating and foundation work have been substantially completed and as each story of structural framing/flooring are nominally completed, provide sufficient temporary lighting in each story of construction.
3. Limit lighting installations to intensities which will accommodate normal access and workmanship requirements, recognizing that each entity performing work requiring higher intensity lighting will provide supplementary plug-in temporary lighting at localized areas where such work is in progress.
4. Provide lighting fixture selections, locations and spacings which will produce the required intensity for normal workmanship at night.
5. As permanent lighting system is accepted as substantially complete make suitable provisions for temporary use thereof and remove unused portions of temporary lighting system. Maintain and operate permanent lighting system until time of final acceptance and transfer of operation to Owner's personnel.

D. Work Assigned to General Contractor:

1. Temporary Enclosure: In each area of construction, as soon as the structural floor work is principally completed and the enclosing wall work is principally completed, provide temporary enclosure of remaining openings if required for dust control and weather conditions. Arrange enclosure work to accommodate access, temporary heating and natural ventilation as required for construction work by all entities on the project.

   a. Construct temporary enclosures of fire-treated lumber/plywood and/or tarpaulins with UL labels and flame spread ratings of 15 or less. Provide translucent, fiber mesh reinforced polyethylene enclosure where

admitting daylight would benefit workmanship and reduce the need for temporary lighting.

b. Remove temporary enclosures as permanent enclosure work is completed.

2. Access Provisions: Provide ramps, stairs, ladders, guard rails, handrails and similar temporary access elements as reasonably required by each entity at the project site, to perform the work and facilitate its inspection during installation. Comply with reasonable requests of governing authorities performing inspections. When permanent stairs are available for access during construction, cover finished surfaces with sufficient protection to ensure freedom from damage and deterioration at time of substantial completion.

E. Work Assigned to HVAC Subcontractor:

1. Temporary Heat: As soon as temporary (or permanent) enclosure is completed for any area of construction and temporary heat is required for scheduled work or required to facilitate proper workmanship and permanent heating system is not yet operable or authorized for use, provide temporary heat service for every entity authorized to do work at project site. Maintain temperatures as indicated by other specification sections for each type of work to be performed.

a. Use hot water where available and, where not available, use gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel-oil heaters bearing UL, FM or other approval labels appropriate for application. Vent fuel burning heaters and equip units with individual space thermostatic controls. Use electric resistance space heaters only where no other more energy efficient type of heater is available and allowable.

b. As permanent heating/cooling system is accepted as substantially complete, for each story or usable portion thereof, make suitable provisions for use thereof in temporary heating and cooling and remove unused portions of temporary heating service. Maintain and operate permanent system for temporary heating/cooling purposes, including service to occupied areas if any, until time of final acceptance and transfer of operation to Owner's personnel for major parts of system if not for entire heating system.

c. Prior to temporary enclosure (or permanent enclosure) of any area of construction, each entity performing work in such area and requiring temporary heating shall be responsible for providing such temporary heat and shall provide localized temporary enclosure as necessary to retain heat. Provide heat with self-contained LP gas or fuel-oil heaters, bearing UL, FM or other approved labels.

2. Temporary Mechanical Ventilation: Wherever natural ventilation of work in progress or newly placed is not sufficient for proper workmanship either with or without temporary heating, provide power ventilators in conjunction with openings in temporary (or permanent) enclosure work. Provide and operate either exhaust or supply fans/blowers or both, sufficient to ventilate the work adequately.

a. As permanent air handling system is accepted as substantially complete for or usable portion thereof, make suitable provisions for use thereof to provide temporary ventilation or in conjunction with the need to provide temporary heating or cooling. Maintain and operate permanent air handling system for temporary ventilating or heating/cooling purposes

including service to occupied areas, if any, until time of final acceptance and transfer of operation to Owner's personnel.

3.3 TEMPORARY SUPPORT FACILITIES:

A. General: The types of temporary support facilities required include, but not by way of limitation, field offices, storage sheds, fabrication sheds, sanitary facilities, drinking water, first aid facilities, bulletin boards, private and public telephones, clocks, thermometer, project identification signs, clean-up facilities, waste disposal service, rodent/pest control and similar miscellaneous general services, all as may be reasonably required for proficient performance of the work and accommodation of every entity's personnel authorized to be at the site including Owner and Architect's personnel. Discontinue and remove temporary support facilities and make incidental similar use of permanent work of the project, only when and in manner authorized by Architect; and if not otherwise indicated, immediately before time of substantial completion. Locate temporary support facilities for convenience of users and for minimum interference with construction activities.

1. Assigned Responsibilities: Except as otherwise specifically indicated, temporary support facilities are work of the Contractor for General Work.

B. Contractor's General Field Office: Provide adequate office area for field office personnel of Contractor for General Work suitably finished, furnished, equipped. Include space for project meetings, with table and chairs for seating not less than 6 persons; cover main walls with tackboard material for posting of notices, progress schedule and similar information.

C. Sanitary Facilities: Starting at time of start of work at project site, provide and maintain self-contained toilet units of type acceptable to governing authorities, adequate (at all stages of construction) for use of personnel at project site. Provide separate facilities for male and female personnel when both sexes are working (in any capacity) at project site. At least at one location provide a piped (wet) hand wash facility with demand-type water heater; except during time when only earthwork and foundation work are in progress, hand wash facilities may be limited to wet type paper hand towels. During construction no contractors' personnel are permitted to use Owner's facilities.

D. Drinking Water: Starting at time of start of work at project site and continuing until time piped potable water drinking fountains (either temporary or permanent) are placed in use at each required location by subcontractor for Plumbing, Provide dispenser type, bottled drinking water with supply of paper cups and waste receptacle at each location. Maintain supply of potable water at each location. Remove drinking water supply as piped sources are placed in operation.

E. Cleaning and Trash Disposal: Contractor and each other entity shall be responsible for daily cleaning up of spillages and debris resulting from its operations and from those of its subcontractors and shall be responsible for complete removal and disposition of hazardous and toxic waste materials. Contractor shall provide containers at grade, sufficient for the depositing (by each entity at project site) of nonhazardous/ nontoxic waste materials and shall remove such waste materials from project site at least weekly during cold weather (daily high temperatures below 50 degrees F and at least twice weekly during mild and warm weather.

3.4 SECURITY/PROTECTION PROVISIONS:

A. General: The types of temporary security and protection provisions required include, but not by way of limitation, fire protection, barricades, warning signs/lights, site enclosure

fences, sidewalk bridges, building enclosure/lockup, personnel security program (theft prevention), environmental protection and similar provisions intended to minimize property losses, personal injuries and claims for damages at project site. Provide security/protection services and systems in coordination with activities and in a manner to achieve 24 hour, 7 day per week effectiveness.

1. Assigned Responsibility: Except as otherwise specifically indicated, security/protection facilities and services are work of the General Contractor. Barricades and warning signs/lights are the responsibility of each entity authorized to perform work at the project site.

B. Inside Security Fence: At earliest reasonable date, enclose portion of main vehicle bay as indicated on the drawings with metal chain link fencing having a floor standing support system capable of preventing unauthorized entry into designated area until deemed unnecessary for the protection of the Owner's contents. refer to the drawings for height and placement.

C. Fire Extinguishers: Provide types, sizes, numbers and locations as would be reasonably effective in extinguishing fires during early stages, by personnel at project site. Provide Type A extinguishers at locations of low potential for either electrical or grease oil flammable liquids fires; provide Type ABC dry chemical extinguishers at other locations; comply with recommendations of NFPA No. 10. Post warning and quick instructions at each extinguisher location and instruct all personnel of each entity authorized to be at project site, at time of their first arrival, on proper use of extinguishers and other available facilities at project site. Post local fire department call number on each telephone instrument at project site.

1. Permanent Fire Protection: Contractor (or subcontractor) responsible for any permanent fire protection work shall complete each facility (or portion of) at earliest reasonable date, make ready for emergency use and instruct personnel at site on availability and proper use.

D. Building Enclosure and Lockup: At earliest possible date, secure building against unauthorized entrance at times when personnel are not working. Provide secure temporary enclosures at ground floor and other locations of possible entry, with locked entrances.

E. Environment Protection Procedures: Contractor shall provide facilities, establish procedures, and conduct construction activities in a manner, which will ensure its compliance with regulations controlling construction activities at project site. Contractor shall designate one person, the Construction Superintendent, or other to enforce strict discipline on activities related to generation of wastes, pollution of air/water/soil, generation of noise and similar harmful or deleterious effects which might violate regulations or reasonably irritate persons at or in vicinity of project site.

END SECTION 01 50 00

SECTION 01 60 00 - PRODUCTS AND SUBSTITUTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. Definitions: "Products" is defined to include purchased items for incorporation into the work, regardless of whether specifically purchased for project or taken from Contractor's stock of previously purchased products. "Materials" is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, installed or applied to form units of work. "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated and particularly including products with service connections (wiring, piping, etc.). Definitions in this paragraph are not intended to negate the meaning of other terms used in contract documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," "special construction" and similar terms which are self-explanatory and have recognized meanings in the construction industry.

B. Substitutions: The requirements for substitutions do not apply to specified Contractor options on products and construction methods. Revisions to contract documents, where requested by Owner, Architect or Engineer, are "changes" not "substitutions." Requested substitutions during bidding period, which have been accepted prior to Contract Date, are included in contract document and are not subject to requirements for substitutions as specified herein. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities do not constitute "substitutions" and do not constitute a basis for change orders, except as provided for in contract documents. Otherwise, Contractor's requests for changes in products, materials and methods of construction required by contract documents are considered requests for "substitutions" and are subject to requirements hereof.

C. Standards: Refer to Division-1 section "Definitions and Standards" for applicability of industry standards to products of project and for acronyms used in text of specification sections.

1.3 QUALITY ASSURANCE:

A. Source Limitations: To the greatest extent possible, provide products, materials and equipment of a singular generic kind and from a single source.

B. Compatibility of Options: Where more than one choice is available as options for Contractor's selection of a product or material, select an option which is compatible with other products and materials already selected (which may have been from among options for those other products and materials). Total compatibility among options is not assured by limitations within contract documents, but must be provided by Contractor. Compatibility is a basic general requirement of product/material selections.

1.4 SUBMITTALS:

A. Requests for Substitutions: Submit 3 copies, fully identified for product or method being replaced by substitution, including related specification section and drawing number(s) and fully documented to show compliance with requirements for substitutions. Include product data/drawings, description of methods, samples where applicable, Contractor's detailed comparison of significant qualities between specified item and proposed substitution, statement of effect on construction time and coordination with other affected work, cost information or proposal and Contractor's statement to the effect that proposed substitution will result in overall work equal to or better than work originally indicated.

1.5 PRODUCT DELIVERY-STORAGE-HANDLING:

A. General: Deliver, handle and store products in accordance with manufacturer's recommendations and by methods and means which will prevent damage, deterioration and loss including theft. Control delivery schedules to minimize long-term storage of products at site and overcrowding of construction spaces. In particular, provide delivery/installation coordination to ensure minimum holding or storage times for products recognized to be flammable, hazardous, easily damaged or sensitive to deterioration, theft and other sources of loss.

1.6 WARRANTIES (GUARANTEES):

A. Categories of Specific Warranties: Warranties on the work are in several categories, including those of General Conditions and including (but not necessarily limited to) the following specific categories related to individual units of work specified in sections of Divisions 2 through 16 of these specifications:

1. Special Project Warranty (Guarantee): A warranty specifically written and signed by Contractor for a defined portion of the work and, where required, countersigned by subcontractor, installer, manufacturer or other entity engaged by Contractor.
2. Specified Product Warranty: A warranty which is required by contract documents to be provided for a manufactured product incorporated into the work regardless of whether manufacturer has published warranty without regard for specific incorporation of product into the work or has written and executed warranty as a direct result of contract document requirements.
3. Coincidental Product Warranty: A warranty which is not specifically required by contract documents (other than as specified in this Section); but which is available on a product incorporated into the work, by virtue of the fact that manufacturer of product has published warranty in connection with purchases and uses of product without regard for specific applications except as otherwise limited by terms of warranty.

B. General Limitations: It is recognized that specific warranties are intended primarily to protect Owner against failure of the work to perform as required and against deficient, defective and faulty materials and workmanship regardless of sources. Except as otherwise indicated, specific warranties do not cover failures in the work which result from: 1) Unusual and abnormal phenomena of the elements, 2) The Owner's misuse, maltreatment or improper maintenance of the work, 3) Vandalism after time of substantial completion or 4) Insurrection or acts of aggression including war.

C. Related Damages and Losses: In connection with Contractor's correction of warranted work which has failed, remove and replace other work of project which has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted work.

D. Consequential Damages: Except as otherwise indicated or required by governing regulation, special project warranties and product warranties are not extended to cover damage to building contents (other than work of Contract) which occurs as a result of failure of warranted work.

E. Reinstatement of Warranty Period: Except as otherwise indicated, when work covered by a special project warranty or product warranty has failed and has been corrected by replacement or restoration, reinstate warranty by written endorsement for the following time period, starting on date of acceptance of replaced or restored work.

1. A period of time ending upon date original warranty would have expired if there had been no failure, but not less than half of original warranty period of time.

F. Replacement Cost, Obligations: Except as otherwise indicated, costs of replacing or restoring failing warranted units or products is Contractor's obligation, without regard for whether Owner has already benefited from use through a portion of anticipated useful service lives.

G. Rejection of Warranties: Owner reserves the right, at time of substantial completion or thereafter, to reject coincidental product warranties submitted by Contractor, which in opinion of Owner tend to detract from or confuse interpretation of requirements of contract documents.

H. Contractor's Procurement Obligations: Do not purchase, subcontract for, or allow others to purchase or subsubcontract for materials or units of work for project where a special project warranty, specified product warranty, certification or similar commitment is required, until it has been determined that entities required to countersign such commitments are willing to do so.

I. Specific Warranty Forms: Where a special project warranty (guarantee) or specified product warranty is required, prepare a written document to contain terms and appropriate identification, ready for execution by required parties. Submit draft to Owner (through Architect or Engineer) for approval prior to final executions.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT COMPLIANCE:

A. General: The compliance requirements, for individual products as indicated in contract documents, are multiple in nature and may include generic, descriptive, proprietary, performance, prescriptive, compliance with standards, compliance with codes, conformance with graphic details and other similar forms and methods of indicating requirements, all of which must be complied with. Also "allowances" and similar provisions of contract documents will have a bearing on selection process.

B. Procedures for Selecting Products: Contractor's options for selecting products are limited by contract document requirements and governing regulations and are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects. Required procedures include, but are not necessarily limited to, the following for various indicated methods of specifying:

1. Single Product/Manufacturer Name: Provide product indicated, except advise Architect/Engineer before proceeding, where known that named product is not a feasible or acceptable selection.
2. Two or More Product/Manufacturer Names: Provide one of the named products,

at Contractor's option; but excluding products which do not comply with requirements. Do not provide or offer to provide an unnamed product, except where none of named products comply with requirements or are a feasible selection; advise Architect/Engineer before proceeding.

3. "Or Approved Equal:" Where named products in specifications text are accompanied by the term "or approved equal," or other language of similar effect, comply with those contract document provisions concerning "substitutions" for obtaining Architect/Engineer's approval (or change order) to provide an unnamed product.
4. "Named" except as otherwise indicated, is defined to mean manufacturer's name for product as recorded in published product literature of latest issue as of date of contract documents. Refer requests to use products of a later (or earlier) model to Architect/Engineer for acceptance before proceeding.
5. Standards, Codes and Regulations: Where compliance with an imposed standard, code or regulation is required, selection from among products which comply with requirements including those standards, codes and regulations is Contractor's option.
6. Performance Requirements: Provide products which comply with specific performances indicated, and which are recommended by manufacturer (in published product literature or by individual certification) for application indicated. Overall performance of a product is implied where product is specified for specific performances.
7. Prescriptive Requirements: Provide products which have been produced in accordance with prescriptive requirements, using specified ingredients and components and complying with specified requirements for mixing, fabricating, curing, finishing, testing and similar operations in manufacturing process.
8. Visual Matching: Where matching of an established sample is required, final judgement of whether a product proposed by Contractor matches sample satisfactorily is Architect's judgement. Where no product within specified cost category is available, which matches sample satisfactorily and complies with requirements, comply with contract document provisions concerning, "substitutions" and "change orders" for selection of a matching product outside established cost category or not complying with requirements.
9. Visual Selection: Except as otherwise indicated, where specified product requirements include "...as selected from manufacturer's standard colors, patterns, textures..." or words of similar effect, the selection of manufacturer and basic product (complying with requirements) is Contractor's option and subsequent selection of color, pattern and texture is Architect's selection. Where specified product requirements include "...as selected from standard colors, patterns, textures available within the industry..." or words to that effect, selection of product (complying with requirements and within established cost category) is Architect's selection, including designation of manufacturer where necessary to obtain desired color, pattern or texture.

2.2 SUBSTITUTIONS:

A. Conditions: Contractor's request for substitution will be received and considered when extensive revisions to contract documents are not required and changes are in keeping with general intent of contract documents; when timely, fully documented and properly submitted and when one or more of following conditions is satisfied, all as judged by Architect/Engineer. Otherwise, requests will be returned without action except to record noncompliance with these requirements.

1. Where request is directly related to an "or approved equal" clause or other language of same effect in contract documents.
2. Where required product, material or method cannot be provided within Contract

Time, but not as a result of Contractor's failure to pursue the work promptly or coordinate various activities properly.

3. Where required product, material or method cannot be provided in a manner which is compatible with other materials of the work or cannot be properly coordinated therewith or cannot be warranted (guaranteed) as required or cannot be used without adversely affecting Owner's insurance coverage on completed work or will encounter other substantial noncompliances which are not possible to otherwise overcome except by making requested substitution, which Contractor thereby certifies to overcome such noncompatibility, noncoordination, nonwarranty, noninsurability or other noncompliance as claimed.
4. Where required product, material or method cannot receive required approval by a governing authority and requested substitution can be so approved.
5. Where substantial advantage is offered Owner, in terms of cost, time or other valuable considerations, after deducting offsetting responsibilities Owner may be required to bear, including additional compensation to Architect/Engineer for redesign and evaluation services, increased cost of other work by Owner or separate contractors and similar considerations.

B. Reimbursement of Architect's Cost:

1. In event substitutions are proposed to the Architect after the date of Contract, the Architect will record all time used by him and his consultants in evaluation of each such proposed substitution.
2. Whether or not the Architect approved a proposed substitution the Contractor shall promptly upon receipt of the Architect's billing reimburse the Architect at their hourly billing rate for the Architect and his consultants for all time spent by them in evaluation of the proposed substitution.

C. Work Related Submittals: Contractor's submittal of and Architect/Engineer's acceptance of shop drawings, product data or samples which indicate work not complying with requirements of contract documents, does not constitute an acceptable and valid request for, or approval of a substitution.

2.3 GENERAL PRODUCT REQUIREMENTS:

A. General: Provide products which comply with requirements and which are undamaged and unused at time of installation and which are complete with accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for intended use and effect.

1. Standard Products: Where available, provide standard products of types which have been produced and used previously and successfully on other projects and in similar applications.
2. Continued Availability: Where additional amounts of a product, by nature of its application, are likely to be needed by Owner at a later date for maintenance and repair or replacement work provide a standard domestically produced product which is likely to be available to Owner at such later date.

B. Nameplates: Except as otherwise indicated for required approval labels and operating data, do not permanently attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view either in occupied spaces or on exterior of the work.

1. Labels: Locate required labels and stamps on a concealed surface or where required for observation after installation on an accessible surface which, in occupied spaces, is not conspicuous.

2. Equipment Nameplates: Provide permanent nameplate on each item of service connected or power operated equipment. Indicate manufacturer, product name, model number, serial number, capacity, speed, ratings and similar essential operating data. Locate nameplates on an easily accessed surface which, in occupied spaces, is not conspicuous.

PART 3 - EXECUTION

Not applicable

END SECTION 01 60 00

SECTION 01 70 00 - PROJECT CLOSEOUT

PART 1- GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. Definitions: Closeout is hereby defined to include general requirements near end of Contract Time, in preparation for final acceptance, final payment, normal termination of contract, occupancy by Owner and similar actions evidencing completion of the work. Specific requirements for individual units of work are specified in sections of Divisions 2 through 33. Time of closeout is directly related to "Substantial Completion" and, therefore, may be either a single time period for entire work or multiple time periods for portions of work, which have been certified as substantially complete at different dates. That time variation (if any) shall be applicable to other provisions of this section.

1.3 PREREQUISITES TO SUBSTANTIAL COMPLETION:

A. General: Prior to requesting Architect/Engineer's inspection for certification of substantial completion (for either entire work or portions thereof), complete the following and list known exceptions in request:

1. In progress payment request coincident with or first following date claimed, show either 100 percent completion for portion of work claimed as "substantially complete" or list incomplete items, value of incompletion and reasons for being incomplete.
2. Include supporting documentation for completion as indicated in these contract documents.
3. Submit statement showing accounting of changes to the Contract Sum.
4. Advise Owner of pending insurance change over requirements.
5. Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents.
6. Obtain and submit releases enabling Owners full and unrestricted use of the work and access to services and utilities, including (where required) occupancy permits, operating certificates and similar releases.
7. Submit record documents, maintenance manuals, damage or settlement survey, property survey and similar final record information. Deliver tools, spare parts, extra stocks of materials and similar physical items to Owner.
8. Make final change over of locks and transmit keys to Owner and advise Owner's personnel of change over in security provisions.
9. Complete start-up testing of systems, and instructions of Owner's operating/maintenance personnel. Discontinue (or change over) and remove from project site temporary facilities and services, along with construction tools and facilities, mock-ups and similar elements.
10. Complete final cleaning up requirements.
11. Touch up and otherwise repair and restore marred exposed finishes.

B. Inspection Procedures: Upon receipt of Contractor's request, Architect/Engineer will either proceed with inspection or advise Contractor of prerequisites not fulfilled. Following initial inspection, Architect/Engineer will either prepare certificate of substantial completion or advise Contractor of work which must be performed prior to issuance of certificate; and repeat inspection when requested and assured that work has been substantially completed. Results of completed inspection will form initial "punch list" for final acceptance.

1.4 PREREQUISITES TO FINAL ACCEPTANCE:

A. General: Prior to requesting Architect/Engineers final inspection for certification of final acceptance and final payment, as required by General Conditions, complete the following and list known exceptions (if any) in request:

1. Submit final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
2. Submit updated final statement, accounting for additional (final) changes to Contract Sum.
3. Submit certified copy of Architect/Engineers final punch list of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by Architect/Engineer.
4. Submit final meter readings for utilities, measured record of stored fuel and similar data as of time of substantial completion or when Owner took possession of and responsibility for corresponding elements of the work.

B. Reinspection Procedure: Upon receipt of Contractor's notice that work has been completed, including punch list items resulting from earlier inspections, and excepting incomplete items delayed because of acceptable circumstances, Architect/Engineer will reinspect work. Upon completion of reinspection, Architect/Engineer will either prepare certificate of final acceptance or advise Contractor of work not completed or obligations not fulfilled as required for final acceptance. If necessary, procedure will be repeated.

1.5 AS-BUILT DRAWINGS SUBMITTALS:

A. General: Specific requirements for as-built drawings are indicated in individual sections of these specifications. Other requirements are indicated in General Conditions. General submittal requirements are indicated in Division 1 Section - "Submittals" section. Do not use as-built drawings for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to as-built for Architect/Engineers reference during normal working hours.

B. As-built Drawings: Maintain a white print set (blue line or black line) of Contract Drawings and shop drawings in clean, undamaged condition, with mark-up of actual installations which vary substantially from the work as originally shown. Mark whichever drawing is most capable of showing "field" condition fully and accurately; however, where shop drawings are used for mark-up, record a cross-reference at corresponding location on Contract Drawings. Mark with red erasable pencil and, where feasible, use other colors to distinguish between variations in separate categories of work. Mark-up new information which is recognized to be of importance to Owner, but was for some reason not shown on either contract drawings or shop drawings. Give particular attention to concealed work, which would be difficult to measure and record at a latter date. Note related change order numbers where applicable. Organize as-built drawing sheets into manageable sets, bind with durable paper cover sheets and print suitable titles, dates and other identification on cover of each set.

1. The working set of drawings maintained by each discipline's field superintendent is un-acceptable for submittal as as-built drawings. Significant marks are to be transferred to a clean white print as specified above.

C. Maintenance Manuals: Organize maintenance and operating manual information into suitable sets of manageable size and bind into individual binders properly identified and indexed (thumb-tabbed). Include emergency instructions, spare parts listing, warranties, wiring diagrams, recommended "turn-around" cycles, inspection procedures, shop drawings, product data and similar applicable information. Bind each manual of each set in a heavy-duty 2", 3 ring vinyl covered binder and include pocket folders for folded sheet information. Mark identification on both front and spine of each binder. Provide a total of two (2) complete bound sets and 2 complete sets in ".pdf" format on Compact Disks of Operation and Maintenance Manuals. Various technical sections of the specifications may require additional submittals of documentation on an individual basis.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES:

A. General Operating/Maintenance Instructions: Arrange for each installer of work requiring continuing maintenance or operation to meet with Owner's personnel at project site to provide basic instruction needed for proper operation and maintenance of entire work. Include instructions by manufacturer's representatives where installers are not expert in the required procedures. Review maintenance manuals, record documentation, tools, spare parts and materials, lubricants, fuels, identification system, control sequences, hazards, cleaning and similar procedures and facilities. For operational equipment demonstrate start-up, shut-down, emergency operations, noise and vibration adjustments, safety, economy/efficiency adjustments and similar operations. Review maintenance and operations in relation with applicable warranties, agreements to maintain, bonds and similar continuing commitments.

3.2 FINAL CLEANING:

A. General: Special cleaning for specific units of work is specified in sections of Divisions 3 through 33. General cleaning during progress of work is specified in General Conditions and as temporary services in "Temporary Facilities" section of this Division. Provide final cleaning of the work, at time indicated, consisting of cleaning each surface or unit of work to normal "clean" condition expected for a first-class building cleaning and maintenance program. Comply with manufacturer's instructions for cleaning operations. The following are examples, but not by way of limitation, of cleaning levels required:

1. Remove labels which are not required as permanent labels.
2. Clean transparent materials, including mirrors and window/door glass, to a polished condition, removing substances which are noticeable as vision obscuring materials. Replace broken glass and damaged transparent materials.
3. Clean exposed exterior and interior hard surfaced finishes, to a dirt free condition, free of dust, stains, films and similar noticeable distracting substances. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective condition.

4. Wipe surfaces of mechanical and electrical equipment clean, including elevator equipment and similar equipment; remove excess lubrication and other substances.
5. Remove debris and surface dust from limited access spaces including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics and similar spaces.
6. Clean concrete floors in unoccupied spaces broom clean.
7. Vacuum clean carpeted surfaces and similar soft surfaces.
8. Clean plumbing fixtures to a sanitary condition, free of stains including those resulting from water exposure.
9. Clean food service equipment to a condition of sanitation ready and acceptable for intended food service use.
10. Clean light fixtures and lamps so as to function with full efficiency.
11. Clean project site (yard and grounds), including landscape development areas, of litter and foreign substances. Sweep paved areas to a broom clean condition; remove stains, petro-chemical spills and other foreign deposits. Rake ground which are neither planted nor paved, to a smooth, even textured surface.

B. Pest Control: Engage an experienced exterminator to make a final inspection of project and to rid project of rodents, insects and other pests.

C. Removal of Protection: Except as otherwise indicated or requested by Architect/Engineer, remove temporary protection devices and facilities which were installed during course of the work to protect previously completed work during remainder of construction period.

D. Compliances: Comply with safety standards and governing regulations for cleaning operations. Do not burn waste materials at site or bury debris or excess materials on Owner's property or discharge volatile or other harmful or dangerous materials into drainage systems; remove waste materials from site and dispose of in a lawful manner.

E. Where extra materials of value remaining after completion of associated work have become Owner's property, dispose of these to Owner's best advantage as directed.

END SECTION 01 70 00

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Division 2 Section "Selective Demolition" for demolition of selected portions of the building for alterations.
2. Divisions 2 through 33 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
3. Requirements in these Sections apply to Fire Suppression, Plumbing, Mechanical and Electrical installations:

    a. Divisions 21 through 26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 DEFINITIONS

A. Cutting: Removal of existing or new construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

A. Prepare cutting and patching documentation to include the following information:

1. Dates: Indicate when cutting and patching will be performed.
2. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
3. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
4. Slip Connections

1.5 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

1. Lintels
2. Headers
3. Fasteners and connections.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-protection systems.
4. Control systems.
5. Communication systems.
6. Electrical wiring systems.

C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, reducing their capacity to perform as intended, or that could result in increased maintenance or decreased operational life or safety.

1. Equipment supports.
2. Piping, ductwork, vessels, and equipment.
3. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm experienced in the work to be performed.

a. Processed concrete finishes.
b. Roofing.
c. Window wall system.
d. Fluid-applied flooring.
e. HVAC enclosures, cabinets, or covers.

E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas. Provide enclosures, barriers or partitions to keep dust and debris out of adjacent areas.

D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid or minimize interruption of services to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
2. Where reuse of existing material is required to patch an opening or architectural element, remove material from existing location with care to preserve enough reusable material to complete the patched areas. In the case of bonded units (such as c.m.u. and brick), carefully remove mortar and bonding agents to result in units having clean working faces or edges.

B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 01 73 29

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. This Section includes the following:

1. Demolition and removal of selected portions of a building or structure.
2. Demolition and removal of selected site elements.
3. Patching and repair procedures for selective demolition operations.

B. Related Sections including the following:

1. Division 1 Section "Summary" for use of the premises.
2. Division 1 Section "Cutting and Patching" for cutting and patching procedures for selective demolition operations.

1.3 MATERIALS OWNERSHIP:

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

1.4 SUBMITTALS:

A. Schedule: Submit proposed methods and operations of building demolition to Architect for review prior to start of work. Include in schedule coordination for shut-off, capping and continuation of utility services as required.

B. Provide a detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.

C. Inventory of items to be removed and salvaged.

D. Inventory of items to be removed by the Owner.

1.5 QUALITY ASSURANCE:

A. Demolition Personnel Qualifications: Engage experienced tradesmen that specialize in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations and State requirements before starting demolition Work. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.6 PROJECT CONDITIONS:

A. Materials and equipment to be removed and not required to be reused will be reviewed by Owner for salvage. Items which Owner does not wish to retain shall be removed from the site by the Contractor. Items to be retained shall be stored at job site where directed by Owner.

B. Condition of Structures: The Owner assumes no responsibility for actual condition of structures to be demolished. Conditions existing at time of inspection for bidding purposes will be maintained by Owner insofar as practicable. However, variations within structure may occur by Owner's removal and salvage operations prior to start of demolition work.

C. Demolition: Items of salvable value to Contractor may be removed from structure as work progresses. Salvaged items must be transported from site as they are removed. Storage or sale of removed items on site will not be permitted.

D. Maintain access to existing walkways and other adjacent facilities.

1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

F. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

PART 2 - PRODUCTS

Not applicable

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. Survey the condition of the building to determine whether removing any element might result in a structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during demolition.

E. Perform surveys as the Work progresses to detect hazards resulting from demolition activities.

F. When unanticipated mechanical, electric, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of

conflict. Notify the Architect of the conditions prior to proceeding with demolition.

3.2 UTILITY SERVICES:

A. Maintain existing utilities indicated to remain, keep in service and protect against damage during demolition operations.

1. Do not interrupt existing utilities serving facility, except when authorized in writing by the Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to the Owner and to authorities having jurisdiction.

B. The Contractor shall disconnect and seal utilities serving each area to be demolished, prior to start of demolition work. The Contractor shall arrange to shut off indicated utilities with utility companies.

C. Refer to Division 21, 22, 23 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utility services. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION:

A. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks and other adjacent occupied or used facilities.

B. Do not close or obstruct streets, walks or other occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

C. Protection: Ensure safe passage of persons around area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities and persons.

1. Erect temporary protection, such as walks, fences, canopies, and covered passageways as required by authorities having jurisdiction.
2. Provide interior and exterior shoring, bracing or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain. Strengthen or add new supports when required during progress of selective demolition.
3. Protect existing site improvements, appurtenances, and landscaping to remain.
4. Provide temporary weather protection, during intervals between demolition and removal of existing construction, on exterior surfaces and new construction to ensure that no water leakage or damage occurs to structure or interior areas.
5. Protect walls, ceilings, floors, and other existing finish work that are to remain and are exposed during selective demolition operations.
6. Cover and protect furniture, furnishings, and equipment that have not been removed.
7. Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise. Insulate partitions to provide noise protection to occupied areas. Seal joints and perimeter. Equip partitions with dustproof doors and security locks. Weatherstrip openings in exterior walls. Construct partitions and temporary enclosures of fire-rated construction where required to maintain existing fire-separation and enclosures between areas.

3.4 POLLUTION CONTROLS:

A. Pollution Controls: Use water mist, temporary enclosures and other suitable methods to limit spread of dust and dirt. Comply with governing regulations pertaining to environmental protection.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

B. Clean adjacent structures and improvements of dust, dirt and debris caused by demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 SELECTIVE DEMOLITION:

A. Perform demolition and removal of existing materials shown on drawings or required to facilitate accomplishment of new work. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition work above each floor or tier before disturbing supporting members on the next lower levels.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct or pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations. Maintain adequate ventilation when using cutting torches.
5. Remove decayed, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
6. Remove structural framing members and lower to ground by method suitable to prevent free fall and to prevent ground impact or dust generation.
7. Locate selective demolition equipment throughout the structure and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
8. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
9. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.

B. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain, using power-driven masonry saw or hand tools; do not use power driven impact tools.

C. Break up and remove concrete slabs on grade indicated to be removed.

D. Remove resilient floor coverings and adhesive according to recommendations of the Resilient Floor Covering Institute's (RFCI) "Recommended Work Practices for the Removal of Resilient Floor Coverings" and Addendum. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

E. Remove no more existing roofing than can be covered in one day by new roofing. See applicable Division 7 Section for new roofing requirements.

3.6 PATCHING AND REPAIRS:

A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective demolition operations.

B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials. Completely fill holes and depressions in existing masonry walls to remain with an approved masonry patching material, applied according to manufacturer's printed recommendations.

C. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction to remain in a manner that eliminates evidence of patching and refinishing.

D. Patch and repair floor and wall surfaces in the new spaces where demolished walls or partitions extend one finish area into another. Provide a flush and even surface of uniform color and appearance.

1. Closely match texture and finish of existing adjacent surface. Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
2. Where patching smooth painted surfaces, extend final paint coat over entire unbroken surface containing the patch after the surface has received primer and second coat.
3. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

E. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 DISPOSAL:

A. Remove demolition debris from project site daily. Do not allow demolished materials to accumulate on-site. Transport demolished materials off Owner's property and legally dispose of them.

B. Do not store or burn materials on site.

3.8 CLEANUP:

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

B. Sweep the building broom clean on completion of selective demolition operations.

END SECTION 02 41 19

CITY OF MADISON
FIRE STATION #2 ADDITION AND REMODELING
Project No. 2011 009

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Foundations and footings
2. Slabs-on-grade
3. Fill for steel deck
4. Topping on precast plank
5. Foundation walls
6. Fill for steel pan stairs

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 3 Section "Precast Structural Concrete" for structural precast concrete.
2. Division 5 Section "Metal Decking" for steel deck construction.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:

1. ACI 117 Standard Specifications for Tolerances for Concrete Construction ands Materials
2. ACI 302 Guide for Concrete Floor and Slab Construction
3. ACI 301 "Specifications for Structural Concrete for Buildings."
4. ACI 318 "Building Code Requirements for Reinforced Concrete."
5. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."

B. Concrete Testing Service: Employ, at Contractor's expense a testing laboratory acceptable to Architect to perform material evaluation tests and to design concrete mixes.

C. Materials and installed work may require testing and retesting, as directed by Architect, at anytime during progress of work. Allow free access to material stockpiles and facilities. Tests, not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

1.4 ALLOWABLE TOLERANCES

A. Flatwork tolerance for random-traffic floors should be measured in accordance with ASTM E1155.

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.

Floor slabs shall conform to the following ACI F-number requirements unless noted otherwise:

1. Slab-On-Grade and Level Suspended Slabs Shored Until After Testing:
   Specified Overall Values - F_F30/F_L20
   Minimum Local Values - F_F15/F_L10
2. Unlevel Shored Suspended Slabs and Unshored Suspended Slabs:
   Specified Overall Value - FF25
   Minimum Local Value - F_F15

D. See ACI 117 for other tolerances not stated herein.

1.5 SUBMITTALS:

A. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Architect.

B. Shop Drawings:

1. Reinforcement: Submit shop drawings (one sepia and one print each) for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required and openings through concrete structures.

C. Samples: Submit samples of materials as specified and as otherwise requested by Architect, including names, sources and descriptions.

D. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test as specified.

E. Material Certificates: Provide material certificates in lieu of materials laboratory test reports when permitted by Architect. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

F. Concrete Mix Design: Submit mix designs in conformance with guidelines in this specification.

PART 2 - PRODUCTS

2.1 FORM MATERIALS:

A. Form for Exposed Finish Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed

surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.

1. Use overlaid plywood complying with U.S. Product Standard PS-1 "B-B High Density Overlaid Concrete Form," Class I.
2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

2.2 REINFORCING MATERIALS:

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Steel Wire: ASTM A 82, plain, cold-drawn, steel.

C. Welded Wire Fabric (WWF): ASTM A 185, welded steel wire fabric.

D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise acceptable.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected, stainless steel protected, or special stainless complying with CRSI Classes C, D, or E, respectively.

2.3 CONCRETE MATERIALS:

A. Portland Cement: ASTM C 150, Type I, unless otherwise acceptable to Architect. Use one brand of cement throughout project, unless otherwise acceptable to Architect.

B. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete. Local aggregates not complying with ASTM C 33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the Architect.

C. Slag Cement:

1. For normal concrete, slag cement shall meet requirements of ASTM C989, Grade 100 or Grade 120 ground granulated blast-furnace slag, or
2. Slag cement shall meet requirements of ASTM C595, Type I(SM) or Type I(S) interground or blended cement.

D. Flyash, conforming with the following standards:

1. ASTM C311 "Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete".
2. ASTM C618 "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete", Class C.

E. Water: Potable.

F. Air-Entraining Admixture: ASTM C 260.

G. Water-Reducing Admixture: ASTM C 494, Type A.

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

"Eucon WR-75"; Euclid Chemical Co.
"Pozzolith 220N"; Master Builders.
"Plastocrete 160"; Sika Chemical Corp.
"Chemtard"; Chem-Masters Corp.

H. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F.

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

"WRDA 19"; W.R. Grace
"PSP"; Protex Industries Inc.
"Sikament"; Sika Chemical Corp.
"Eucon Super 37"; Euclid Chemical Co.
"LA-8"; Master Builders
"Rheobuild 1000"; Master Builders

I. Water-Reducing, Accelerator Admixture: ASTM C 494, Type C or E.

Products: Subject to compliance with requirements, provide one of the following: (Shall contain no chloride ions)

"Accelguard HE"; Euclid Chemical Co.
"Pozzolith 122-HE"; Master Builders
"Darex"; W.R. Grace
"Sikacrete"; Sika Chemical Co.

J. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.

Products: Subject to compliance with requirements, provide one of the following:

"Pozzolith 300-R"; Master Builders
"Eucon Retarder 75"; Euclid Chemical Co.
"Daratard"; W.R. Grace
"Plastiment"; Sika Chemical Co.

K. Calcium Chloride: Not permitted.

2.4 RELATED MATERIALS:

A. Nonshrink Grout: CRD-C 588, factory pre-mixed grout.

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

a. Type D, Nonmetallic:

"Masterflow 713"; Master Builders
"Sonogrout"; Sonneborn-Contech
"Euco-NS"; Euclid Chemical Co.
"Duragrout"; L & M Const. Chemical Co.
"Sealtight 588"; W.R. Meadows, Inc.

B. Slab-On-Grade Poly Fiber Reinforcement System:

1. Synthetic Macro Fiber Reinforcement: Provide synthetic structural fibers complying with the following requirements:

a. Synthetic macro fibers shall meet requirements of ASTM C 1116, Paragraph 4.1.3, Type III.
b. Synthetic macro fibers shall be monofilament, made of polypropylene or polypropylene/polyethylene blend.
c. Synthetic macro fibers shall have a minimum length of 1.50 inches (38 mm).
d. Specific gravity between 0.90 and 0.95
e. Synthetic macro fibers shall have an aspect ratio (length divided by equivalent diameter of fiber) between 60 and 100.
f. Dosage rate will be 5.0 #/CY for slabs 4 inches in thickness and 6.5#/CY for precast topping.
g. Synthetic macro fibers shall be:

1) Grace STRUX® 90/40 synthetic fiber
2) Novomesh® 650 synthetic fiber by SI Concrete Systems
3) Tuf-Strand SF by Euclid Chemical Company

C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

D. Moisture-Retaining Cover:

1. One of the following, complying with ASTM C 171.

a. Waterproof paper.
b. Polyethylene film.

E. Liquid Membrane-Forming Curing Compound: Federal Spec TT-C-800, Type I, unless other type acceptable to Architect.

1. Products offered by manufacturers to comply with the requirements for membrane-forming curing compounds include the following:

"Klearseal"; Setcon Industries
"Floor Coat"; Euclid Chemical Co.
"MB-429"; Master Builders
"Kure N Seal 800"; Sonneborn-Contech
"Klorkure 800"; Setcon Industries
"Clear Seal 800"; W.R. Grace
"Dress and Seal"; L & M Const. Chemicals Co.
"Sealco 800"; Gifford-Hill
"Sealtight CR-26-GSA"; W.R. Meadows, Inc.

"Acrylic Cure" DSG Chemical Div.

F. Liquid Membrane-Forming Curing Compound: ASTM C 309, Type I, Class B, VOC compliant, unless other type acceptable to Architect.

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

"AH Clear Cure WB;" Anti-Hydro International, Inc.
"Safe-Cure & Seal 20;" ChemMasters
"High Seal;" Conspec Marketing & Manufacturing Co., Inc.
"Safe Cure and Seal;" Dayton Superior Corporation
"Diamond Clear VOX;" Euclid Chemical Co.
"Dress & Seal WB;" L & M Construction Chemicals, Inc.
"Vocomp-20;" W.R. Meadows, Inc.
"Cure 7 Seal 100E;" Nox-Crete Products Group, Kinsman Corporation
"Kure-N-Seal W;" Sonneborn, Div. of ChemRex, Inc.
"Cure & Seal 14 percent;" Symons Corporation
"Horncure 100;" Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America

G. Bonding Compound: Polyvinyl acetate, rewettable type.

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

"DSG J-40"; DSG Chemical Div.
"Weldcrete"; Larson Products
"Everbond"; L & M Constr. Chemicals Co.
"EucoWeld"; Euclid Chemical Co.
"Daraweld C"; W.R. Grace
"Sonocrete"; Sonneborn-Contech
"Sealtight Intralok"; W.R. Meadows, Inc.

H. Epoxy Adhesive: 100 percent solids, two component material suitable for use on dry or damp surfaces.

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

"Concresive Standard Liquid"; Master Builders, Inc.
"Sikadur 32 Hi-Mod"; Sika Corp.
"Euco Epoxy System #452 or #620"; Euclid Chemical Co.
"Rezi-Weld 1000"; W.R. Meadows, Inc.

I. Vapor Barrier: Provide vapor barrier over prepared base coarse. 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 E96	less than 0.008
b.	Water Vapor Barrier	ASTM E1745	Class A

2. Provide one of the following:

a. Stego Wrap (15 mil) Vapor Barrier by Stego Industries LLC
b. W.R. Meadows Premoulded Membrane with Plasmatic Core
c. Zero-Perm by Alumiseal

2.5 PROPORTIONING AND DESIGN OF MIXES:

A. Prepare design mixes for each type and strength of concrete in accordance with applicable provisions of ASTM C 94. Use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall be the same as used for field quality control testing unless otherwise acceptable to Architect.

B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Architect.

C. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:

MIX PROPORTIONING

Class	Type of Construction	Min. Comp Strength @ 28 Days (PSI)	Max. Agg. Size (In.)	Max W/C Ratio.	Air Entrain-ment % +/- 1½%	Notes
1	All Footings	3000	1.5	0.68	None	(2)
2	Ext. Walls/Piers	3000	0.75	0.53	6.0	(1)(3)
3	Interior Slab on Grade	3000	0.75	0.55	None	(1)(3)(4)
4	Exterior Slab on Grade	4500	0.75	0.45	6.0	(1)(3)(4)
5	Fill Metal Deck	3500	0.75	0.52	None	(3)
6	Precast Topping	4000	0.75	0.50	None	(1)(3)(4)
7	Metal Pan Stairs	4000	0.375	0.50	None	(3)(4)
8	Miscellaneous Non-Scheduled Concrete Work	3000	0.75	0.55	6.0	(3)

Notes:

(1) Provide at Contractor's option, a super plasticizer to mix.

(2) 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.

(3) 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.

(4) Provide synthetic macro fiber reinforcing to the mix at dosage rate as noted in the Products section

2.6 CONCRETE MIXING:

A. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch machine mixer. For mixers of one cubic yard, or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of the batch is released. For mixers of capacity larger than one cubic yard, increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cubic yard, or fraction thereof.

B. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

C. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to the batch will not be permitted.

D. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required. When air temperature is between 85 degrees F and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMS:

A. Design, 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.

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

C. Construct forms complying with ACI 347, to sizes shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. 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.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast 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 the like, to prevent swelling and for easy removal.

E. 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.

F. Chamfer exposed corners and edges as indicated, using wood, metal PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

G. Form Ties:

1. Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.
2. Unless otherwise indicated, provide ties so portion remaining within concrete after removal is at least 1-1/2 inch inside concrete.
3. Unless otherwise shown, provide form ties which will not leave holes larger than 1 inch diameter in concrete surface.

H. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

I. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement if required to eliminate mortar leaks and maintain proper alignment.

3.2 PLACING REINFORCEMENT:

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

C. Accurately 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 at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.3 JOINTS:

A. Construction Joints: Locate and install construction joints, which are not shown on drawings, so as not to impair strength and appearance of the structure, as acceptable to Architect.

B. Provide keyways at least 1-1/2 inch deep in construction joints in walls, slabs and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.

C. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.

D. Isolation Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated.

E. Control Joints in Slabs-on-Grade: Construct control joints in slabs-on-grade to form panels of patterns as shown. Use inserts 1/4 inch wide x 1/5 to 1/4 of the slab depth, unless otherwise indicated.

F. Form control joints by inserting premolded hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. After concrete has cured, remove inserts and clean groove of loose debris.

3.4 INSTALLATION OF EMBEDDED ITEMS:

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.

B. Edge Forms and Screed Strips for Slabs: 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 sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

3.5 PREPARATION OF FORM SURFACES:

A. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

B. 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.

C. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.6 CONCRETE PLACEMENT:

A. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

B. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

C. Prior to placing topping on precast concrete plank, broom apply a bonding slurry of 3 parts sand and one part Portland Cement. Do not precede the pour too far, allowing the slurry to dry. Slurry shall remain wet at time of topping deposition.

D. General: Comply with ACI 304, and as herein specified. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section

cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

E. Placing Concrete in Forms: 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 60 feet between construction joints.

F. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.

G. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. 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.

H. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

I. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

J. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

K. Maintain reinforcing in proper position during concrete placement operations.

L. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F, and not more than 80 degrees F at point of placement.

M. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions or low temperatures in compliance with ACI 306 "Cold Weather Concreting."

N. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

O. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

P. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

Q. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 "Hot Weather

Concreting". Do not place concrete when air temperature is above 90 degrees F, consult Engineer.

R. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing.

S. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

T. Wet forms thoroughly before placing concrete. Do not use retarding admixtures unless otherwise accepted in mix designs.

3.7 FINISH OF FORMED SURFACES:

A. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, painting or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

C. Smooth Rubbed Finish:

1. Provide smooth rubbed finish to scheduled concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal.
2. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.8 MONOLITHIC SLAB FINISHES:

A. Float Finish:

1. Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.
2. After screeding and consolidating concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance not exceeding 1/4 inch in 10 feet when tested with a 10 foot straight edge. Cut down

high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

B. Trowel Finish:

1. Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, paint or other thin film finish coating system.
2. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8 inch in 10 feet when tested with a 10 foot straightedge. Grind smooth surface defects which would telegraph through applied floor covering system.

C. Nonslip Broom Finish:

1. Apply nonslip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.
2. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

H. Slabs with synthetic fiber reinforcement: it is intended that slab surfaces of slabs with fiber reinforcement be equal to representative finishes of slabs without fiber reinforcement. Contractor shall consult with fiber supplier for proper finishing techniques and finishing operation timing to achieve desired results.

3.9 CONCRETE CURING AND PROTECTION:

A. General:

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
2. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours.
3. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining cover curing, by membrane curing, and by combinations thereof, as herein specified.

1. Provide moisture curing by following methods:

   a. Keep concrete surface continuously wet by covering with water.
   b. Continuous water-fog spray.
   c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4 inch lap over adjacent absorptive covers.

2. Provide moisture-cover curing as follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width

with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Provide membrane curing to slabs as follows:

a. Apply membrane-forming curing compound to concrete surfaces as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

b. **Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring, painting, decorative concrete stains and other coatings and finish materials, unless otherwise acceptable to Architect.**

C. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides 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 methods specified above, as applicable.

D. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing compound.

E. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

F. Use moisture curing on floors in rooms receiving resinous flooring.

3.10 REMOVAL OF FORMS:

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F. for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

C. Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.11 REUSE OF FORMS:

A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

3.12 MISCELLANEOUS CONCRETE ITEMS:

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.

C. Steel Pan and Cast Concrete Stairs: Provide concrete fill for steel pan stair treads and landings and associated items.

3.13 CONCRETE SURFACE REPAIRS:

A. Patching Defective Areas:

1. Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.
2. Cut out honeycomb, rock pockets, voids over 1/4 inches 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 the concrete surface. Before placing cement mortar or proprietary patching compound, thoroughly clean, dampen with water and brush-coat the area to be patched with neat cement grout, or proprietary bonding agent.

B. 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.

C. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, 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.

D. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

E. 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 herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope.

F. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, included crazing, cracks in excess of 0.01 inch wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.

G. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.

H. 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 patching compounds may be

used when acceptable to Architect.

I. 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 brush with a neat cement grout, or apply a concrete bonding agent. 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 the same manner as adjacent concrete.

J. 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 brush with neat cement grout, or apply concrete bonding agent. Mix dry-pack, consisting of one 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. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

K. Use epoxy-based mortar for structural repairs, where directed by Architect.

3.14 QUALITY CONTROL TESTING DURING CONSTRUCTION:

A. The Contractor will employ a testing laboratory to perform tests and to submit test reports.

B. Sampling and testing for quality control during placement of concrete shall include the following enumerated list. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

1. Slump: ASTM C 143; one test for each concrete load at point of discharge; and one test for each set of compressive strength test specimens.
2. Air Content: ASTM C 173, volumetric method for lightweight concrete; ASTM C 231 pressure for normal weight concrete; one for each set of compressive strength test specimens.
3. Concrete Temperature: Test hourly when air temperature is 40 degrees F and below, and when 80 degrees F, and above; and each time a set of compression test specimens made.
4. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
5. Compressive Strength Tests: ASTM C 39; one set for each 100 cubic yards. or fraction thereof, of each concrete class placed in any one day or for each 5,000 sq. ft. of surface area placed; 1 specimen tested at 7 days, 2 specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

C. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

D. When total quantity of a given class of concrete is less than 50 cubic yards, strength test may be waived by Architect if, in his judgment, adequate evidence of satisfactory strength is provided.

E. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

F. Test results shall be reported in writing to Architect and Contractor on same day that tests are made. Reports of compressive strength tests shall contain the 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; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

G. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

END SECTION 03 30 00

SECTION 03 41 00 - PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes structural precast concrete units, including the following:

1. Hollow slab units

B. Related Sections: The following sections contain requirements that relate to this Section.

1. Cast-in-place Concrete is specified in Division 3 Section "Cast-in-Place Concrete."
2. Joint sealants and backing are specified in Division 7 Section "Joint Sealers." Applied finishes are specified in Division 9 Sections.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except as otherwise indicated:

1. ACI 301 "Specifications for Structural Concrete for Buildings."

2. ACI 318 "Building Code Requirements for Reinforced Concrete."

3. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."

4. Prestressed Concrete Institute MNL 116, "Manual for Quality Control for Plants and Production of Precast Concrete Products."

5. Prestressed Concrete Institute MNL 120, "Design Handbook, Precast and Prestressed Concrete."

6. Prestressed Concrete Institute MNL-127, "Recommended Practice for Erection of Precast Concrete."

B. Manufacturer shall be a producer member of the Prestressed Concrete Institute (PCI) and participate in its Plant Certification Program.

C. Installation Tolerances: Install precast units without exceeding following tolerance limits:

1. Variations from Level or Elevation: 1/4-inch in any 20 foot run; 1/2-inch in any 40 foot run; total plus or minus 1/2-inch at any location.

2. Variation from Position in Plan: Plus or minus 1/2-inch maximum at any location.

3. Offsets in Alignment of Adjacent Members at Any Joint: 1/16-inch at any 10 foot run; 1/4-inch maximum.

1.4 SUBMITTALS:

A. 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. Provide layout, dimensions and identification of each precast unit corresponding to sequence and procedure of installation. Indicate welded connections by AWS standard symbols. Detail inserts, connections and joints including accessories and construction at openings in precast units. Indicate camber at initial transfer of prestressing and at time of erection for prestressed units.

3. Provide location and details of anchorage devices that are to be embedded in other construction. Furnish templates if required for accurate placement

4. Include erection procedure for precast units and sequence of erection.

B. Provide manufacturer's complete design calculations prepared by a structural engineer registered 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.

C. Submit documentation which identifies the grout type and manufacturer used along with current supporting literature.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Deliver precast concrete units to project site in such quantities and at such times to insure continuity of installation. Store units at project site to ensure against cracking, distortion and staining or other physical damage and so that markings are visible. Lift and support units at designated lift points.

B. Deliver anchorage items which are to be embedded in other construction before start of such work. Provide setting diagrams, templates, instructions and directions as required for installation.

PART 2 - PRODUCTS

2.1 FORMWORK:

A. Provide forms and, where required, form facing materials of metal, plastic, wood or other acceptable material that is nonreactive with concrete and will produce required finish surfaces.

B. Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete placing operations, temperature changes and when prestressed, pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines and dimensions indicated within specified fabrication tolerances.

C. Unless forms for plant manufactured prestressed concrete units are stripped prior to detensioning, design forms so that stresses are not induced in precast units due to deformation of concrete under prestress or to movement during detensioning.

2.2 REINFORCING MATERIALS:

A. Reinforcing Bars: ASTM A 615, Grade 60, unless otherwise indicated.

B. Steel Wire: ASTM A 82, plain, cold-drawn, steel.

C. Welded Wire Fabric: ASTM A 185.

D. Welded Deformed Steel Wire Fabric: ASTM A 497.

E. Supports for Reinforcement:

1. Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing, complying with CRSI recommendations.

2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are hot-dip galvanized, plastic protected or stainless steel protected.

2.3 PRESTRESSING TENDONS:

A. Uncoated, 7-wire stress relieved strand complying with ASTM A 416. Use grade 250 unless grade 270 required or shown on drawings.

B. Strand similar to above, but having size and ultimate strength of wires increased so that ultimate strength of the strand is increased approximately 15 percent or strand with increased strength but with fewer number of wires per strand may be used at manufacturer's option.

2.4 CONCRETE MATERIALS:

A. Portland Cement: ASTM C 150, Type I or Type III. Use only one brand and type of cement throughout the project, unless otherwise acceptable to Architect.

B. Aggregates: ASTM C 33.

C. Water: Potable or free from foreign materials in amounts harmful to concrete and embedded steel.

D. Air Entraining Admixture: ASTM C 260.

E. Water Reducing Admixture: ASTM C 494, Type A.

F. Calcium Chloride: Do not use calcium chloride in precast prestressed concrete.

2.5 CONNECTION MATERIALS:

A. Steel Plates: Structural quality, hot-rolled carbon steel, ASTM A 283, grade C.

B. Steel Shapes: ASTM A 36.

C. Anchor Bolts: ASTM A 307, low-carbon steel bolts, regular hexagon nuts and carbon steel washers.

D. Finish of Steel Units: Exposed units galvanized per ASTM A 153; others painted with rust inhibitive primer.

E. Bearing Pads: Provide bearing pads for precast concrete units as indicated below.

1. Use the following at beam bearing locations:

a. Plastic shims: Shall be used at hollow core plank locations. Acceptable type and manufacturer is Korolath by Koro.

2. Tempered Hardboard Pads: Not allowed.

F. Accessories: Provide clips, hangers and other accessories required for installation of project units and for support of subsequent construction or finishes.

2.6 GROUT MATERIALS:

A. Cement Grout: Portland Cement, ASTM C 150, Type I and clean, natural sand ASTM C 404. Mix at ratio of 1.0 part cement to 3.0 parts sand, by volume with minimum water required for placement and hydration.

B. NonMetallic, Shrinkage Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with ASTM C-1107, Grade B.

2.7 PROPORTIONING AND DESIGN OF MIXES:

A. Prepare design mixes for each type of concrete required.

B. Design Mixes may be prepared by an independent testing facility or by qualified precast manufacturing plant personnel, at precast manufacturer's option.

C. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each type of concrete required, complying with ACI 318.

1. Produce standard weight concrete consisting of specified Portland cement, aggregates, admixtures and water to produce the following properties.

a. Compressive strength; 5000 psi minimum at 28 days.
b. Release strength for prestressed units: 3500 psi.

D. Submit written reports to Architect of proposed mix for each type of concrete for at least 15 days prior to start of precast unit production. Do not begin concrete production until mixes and evaluations have been reviewed by Architect.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results or other circumstances warrant. Laboratory test data for revised mix designs and strength results must be submitted to and accepted by Architect before using in the work.

F. Admixtures:

1. Use air-entraining admixture in concrete, unless otherwise indicated.

2. Use water reducing admixtures in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion or provide increased workability for low-slump concrete, may be used, subject to Architect's acceptance.

3. Use amounts as recommended by admixture manufacturer for climatic conditions prevailing at time of placing. Adjust quantities of admixtures as required to maintain quality control.

2.8 FABRICATION:

A. General: Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations and dimensional tolerances of PCI MNL-116 and as specified for types of units required.

B. Job Site Mixing: Mix materials for concrete in an acceptable drum type batch machine mixer. For mixers of one cu. yd. or smaller capacity continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cu. yd. or fraction thereof.

C. Provide a batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity and amount of water introduced.

D. Ready Mix Concrete: Comply with requirements of ASTM C 94 and as herein specified. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to batch will not be permitted.

E. During hot weather or under conditions contributing to rapid setting of concrete a shorter mixing time than specified in ASTM C 94 may be required. When the air temperature is between 85 degrees F and 90 degrees F reduce mixing and delivery time from 1-1/2 hours to 75 minutes and when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

F. Built-in Anchorages: Accurately position built-in anchorage devices and secure to formwork. Locate anchorages where they do not affect position of main reinforcement or placing of concrete. Do not relocate bearing plates in units unless acceptable to Architect.

G. Cast-in holes for openings larger than 10 inch diameter or 10 inch square in accordance with final shop drawings. Other smaller holes will be field cut by trades requiring them, as acceptable to Architect.

H. Coat surfaces of forms with bond-breaking compound before reinforcement is placed. Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces requiring bond or adhesion. Apply in compliance with manufacturer's instructions.

I. Clean reinforcement of loose rust and mill scale, earth and other materials which reduce or destroy bond with concrete.

J. Accurately 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.

K. Place reinforcement to obtain at least the minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

L. Pretensioning of tendons for prestressed concrete may be accomplished either by single strand tensioning method or multiple strand tensioning method. Comply with PCI MNL-116 requirements.

M. Place concrete in a continuous operation to prevent formation of seams or planes of weakness in precast units, complying with requirements of ACI 304. Thoroughly consolidate placed concrete by internal and external vibration without dislocation or damage to reinforcement and built-in items.

N. Identification: Provide permanent markings to identify pick-up points and orientation in structure, complying with markings indicated on final shop drawings. Imprint date of casting on each precast unit on a surface which will not show in finished structure.

O. Curing by low pressure steam, by steam vapor, by radiant heat and moisture or other similar process may be employed to accelerate concrete hardening and to reduce curing time.

P. Delay detensioning of prestressed units until concrete has attained at least 70 percent of design stress, as established by test cylinders.

Q. If concrete has been heat cured, perform detensioning while concrete is still warm and moist to avoid dimensional changes which may cause cracking or undesirable stresses in concrete.

R. Detensioning of pretensioned tendons may be accomplished either by gradual release of tensioning jacks or by heat cutting tendons using a sequence and pattern to prevent shock or unbalanced loading.

S. Finish of Formed Surfaces: Provide finishes for formed surfaces of precast concrete as indicated for each type of unit and as follows:

1. Standard Finish: Normal plant run finish produced in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal form joint marks and minor chips and spalls will be tolerated, but no major or unsightly imperfections, honeycomb or structural defects will be permitted.

T. Finish of Unformed Surfaces:

1. Apply trowel finish to unformed surfaces unless otherwise indicated. Consolidate concrete, bring to proper level with a straightedge, float and trowel to a smooth uniform finish.

2. Apply scratch finish to precast units which will receive concrete topping after installation. Following initial strikeoff, transversely scarify surface to provide ridges approximately 1/4 inch deep.

2.9 HOLLOW SLAB UNITS:

A. Type: Precast prestressed concrete units with open voids running full length of slabs, produced under a rigid factory inspected process acceptable to Architect.

B. Furnish units which are free of voids or honeycomb with straight true edges and surfaces.

C. Provide " Standard Finish" units unless otherwise indicated.

D. Fabrication: Manufacturer units of concrete materials which will provide a minimum 3500 psi compressive strength at time of initial prestress and a 28 day compressive strength of 5000 psi.

E. Adequately reinforce slab units to resist transporting and handling stresses.

F. Include cast-in weld plates where required for anchorage or lateral bracing to structural steel members.

G. Cooperate with other trades for installation of items to be cast-in hollow slab units. Notify Contractor of items not received in ample time so as to not delay work.

H. Provide solid, monolithic precast slab units indicated to be an integral part of hollow slab unit system. Design and fabricate solid units to dimensions and details indicated, as specified for hollow slab units.

I. Provide headers of cast-in-place concrete or structural steel shapes for openings larger than one slab width in accordance with hollow slab unit manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Erector must examine supporting structure and conditions under which precast concrete work is to be erected and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Erector.

3.2 INSTALLATION, GENERAL:

A. Bearing Pads: Install flexible bearing pads where indicated, as precast units are being erected. Set pads on level, uniform bearing surfaces and maintain in correct position until precast units are placed.

B. Welding: Perform welding in compliance with AWS D 1.0 and D 12.1, including qualification of welders.

C. Protect units from damage by field welding or cutting operations and provide noncombustible shield as required.

D. Repair damaged metal surfaces by cleaning and applying a coat of liquid galvanizing repair compound to galvanized surfaces and compatible primer to painted surfaces.

E. Powder Actuated Fasteners: Do not use powder actuated fasteners for surface attachment of accessory items in precast, prestressed unit unless otherwise accepted by precast manufacturer.

F. Grouting Connections and Joints: After precast concrete units have been placed and secured, grout open spaces at connection and joints as follows.

1. Cement Grout consisting of 1 part Portland cement, 2-1/2 parts sand and only enough water to properly mix and for hydration.

2. Shrinkage resistant grout consisting of premixed compound and water to provide a flowable mixture without segregation or bleeding.

3. Provide forms or other acceptable method to retain grout in place until sufficiently hard to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, plumb and level with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it hardens.

3.3 PLANT QUALITY CONTROL EVALUATIONS:

A. The Owner may employ a separate testing laboratory to evaluate precast manufacturer's quality control and testing methods.

B. The precast manufacturer shall allow Owners testing facility access to materials storage areas, concrete production equipment and concrete placement and curing facilities. Cooperate with Owner's testing laboratory and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation.

C. Dimensional Tolerances: Units having dimensions smaller or greater than required and outside specified tolerance limits will be subject to additional testing as herein specified.

D. Precast Units having dimensions greater than required will be rejected if appearance or function of the structure is adversely affected or if larger dimensions interfere with other construction. Repair or remove and replace rejected units as required to meet construction conditions.

E. Strength of Units: The strength of precast concrete units will be considered potentially deficient if the manufacturing processes fail to comply with any of the requirements which may affect the strength of the precast units, including the following conditions.

1. Failure to meet compressive strength tests requirements.

2. Reinforcement and pretensioning and detensioning of tendons of prestressed concrete, not conforming to specified fabrication requirements.

3. Concrete curing and protection of precast units against extremes in temperature, not as specified.

4. Precast units damaged during handling and erection.

F. Testing Precast Units: When there is evidence that strength of precast concrete units does not meet specification requirements, the concrete testing service shall take cores drilled from hardened concrete for compressive strength determination, complying with ASTM C 42 and as follows:

1. Take at least 3 representative cores from precast units of suspect strength, from locations directed by Architect.

2. Test cores in a saturated-surface-dry condition per ACI 318 if concrete will be wet during use of completed structure.

3. Test cores in an air dry condition per ACI 318 if concrete will be dry during use of completed structure.

4. Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least 85 percent of 28 day design compressive strength.

5. Tests results will be made in writing on same day that tests are made with copies to Architect, Contractor and precast manufacturer. Include in test reports the project identification name and number, date, name of precast concrete manufacturer, name of concrete testing service, identification letter, number and type of member or members represented by core tests, design compressive strength, compression breaking strength and type of break (corrected for length diameter ratio), direction of applied load to core with respect to horizontal plan of concrete as placed and moisture condition of core at time of testing.

G. Patching: Where core test results is satisfactory and precast units are acceptable for use in work, fill core holes solid with patching mortar and finish to match adjacent concrete surfaces.

H. Defective Work: Precast concrete units which do not conform to specified requirements, including strength, tolerances and finishes shall be replaced with precast concrete units that meet requirements of this section. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections to precast concrete work.

END SECTION 03 41 00

SECTION 03 45 00 - PRECAST ARCHITECTURAL CONCRETE

GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. This Section includes the following:

1. Precast architectural concrete units furnished to Mason Contractor:

a. Column caps.

B. Related Sections include the following:

1. Division 4 Section "Unit Masonry" for full-size brick facing, mortar, and anchorages.
2. Division 7 Section "Flashing and Sheet Metal" for flashing receivers and reglets.
3. Division 7 Section "Joint Sealers" for elastomeric joint sealants and sealant backings.

1.3 PERFORMANCE REQUIREMENTS:

A. Structural Performance: Provide precast architectural concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Dead Loads: none.
2. Live Loads: none.
3. Wind Loads: 30 psf.

1.4 SUBMITTALS:

A. Product Data: For each type of product indicated.

B. Design Mixes: For each concrete mix.

C. Shop Drawings: Detail fabrication and installation of precast architectural concrete units. Indicate member locations, plans, elevations, dimensions, shapes, cross sections, limits of each finish.

D. Samples: For each type of finish indicated on exposed surfaces of precast architectural concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected.

E. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Concrete materials.
2. Water-absorption test reports.

1.5 QUALITY ASSURANCE:

A. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in manufacturing precast architectural concrete units similar to those indicated for this Project and with a record of successful in-service performance.

1. Assumes responsibility for engineering precast architectural concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL 120, "PCI Design Handbook--Precast and Prestressed Concrete."

C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Deliver precast architectural concrete units to Project site in such quantities and at such times to ensure continuity of installation. Store units at Project site to prevent cracking, distorting, warping, staining, or other physical damage, and so markings are visible.

1.7 SEQUENCING:

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MOLD MATERIALS:

A. Molds: Provide molds and, where required, form-facing materials of metal, plastic, wood, or another material that is nonreactive with concrete and dimensionally stable to produce continuous and true precast concrete surfaces within fabrication tolerances and suitable for required finishes

2.2 REINFORCING MATERIALS (Note that some may not be used in this Project):

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

C. Galvanized Reinforcing Bars: ASTM A 767, Class II zinc coated, hot-dip galvanized after fabrication and bending, as follows:

1. Steel Reinforcement: ASTM A 615, Grade 60, deformed.

D. Plain-Steel Wire: ASTM A 82, galvanized.

E. Deformed-Steel Wire: ASTM A 496.

F. Reinforcing Coverage: 1-1/2 inch minimum.

2.3 CONCRETE MATERIALS:

A. Portland Cement: ASTM C 150, Type I or Type III, buff, of same type, brand, and source.

1. Standard gray Portland cement may be used for nonexposed backup concrete.

B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S.

1. Face-Mix Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining.
2. Face-Mix Fine Aggregates: Selected, natural or manufactured sand of the same material as coarse aggregate, unless otherwise approved by Architect.

C. Lightweight Aggregates: ASTM C 330.

D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

F. Water-Reducing Admixture: ASTM C 494, Type A.

G. Retarding Admixture: ASTM C 494, Type B.

H. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

I. Plasticizing Admixture: ASTM C 1017.

2.4 GROUT MATERIALS:

A. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application.

2.5 CONCRETE MIXES:

A. Prepare design mixes for each type of concrete required.

B. Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast architectural concrete fabricator's option.

C. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318.

D. Water Absorption: maximum 6% percent by volume, tested according to PCI MNL 117.

E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

F. When included in design mixes, add other admixtures to concrete mixes according to manufacturer's written instructions.

2.6 MOLD FABRICATION:

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing operations.

B. Maintain molds to provide completed precast architectural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Edge and Corner Treatment: Uniformly chamfered.

C. Form Release agent and similar contaminants shall be removed from edges of elements to receive sealant.

2.7 FABRICATION:

A. Cast-in Anchors, Inserts 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 precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

B. Furnish loose steel clip angles, anchors, dowels and other hardware shapes for securing precast architectural concrete units to supporting and adjacent construction.

C. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" and PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
3. Place reinforcement to maintain at least 3/4-inch minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
4. All reinforcement shall be hot-dipped galvanized or epoxy coated.

D. Reinforce precast architectural concrete units to resist handling, transportation, and erection stresses.

E. Mix concrete according to PCI MNL 117 and requirements in this Section. After concrete batching, no additional water may be added.

F. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 117 for measuring, mixing, transporting, and placing concrete.

G. Comply with ACI 306.1 procedures for cold-weather concrete placement.

H. Comply with ACI 305R recommendations for hot-weather concrete placement.

I. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Provide 7 day minimum moisture curing.

J. Discard precast architectural concrete units that are warped, cracked, broken, spalled, stained, or otherwise defective unless repairs are approved by Architect.

K. All wash surfaces shall be sloped, and drips provided in the bottom of the elements where exposed.

2.8 FABRICATION TOLERANCES:

A. Fabricate precast architectural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

B. Fabricate precast architectural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with the following product tolerances (Note that some may not apply to this Project):

1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:

a. 10 feet or under, plus or minus 1/8 inch.

2. Bowing: Plus or minus L/360, maximum 1 inch.
3. Local Smoothness: 1/4 inch per 10 feet.
4. Warping: 1/16 inch per 12 inches of distance from the nearest adjacent corner.

2.9 FINISHES:

A. Finish exposed-face surfaces of precast architectural concrete units to match approved samples and as follows:

1. Smooth-Surface Finish: Provide surfaces free of pockets, sand streaks, and honeycombs, with uniform color and texture.

B. Finish exposed top and bottom surfaces of precast architectural concrete units to match face-surface finish.

C. Finish unexposed surfaces of precast architectural concrete units by float finish.

D. Cracking and unsightly appearance is not acceptable.

E. Waterproofing of finishes is not acceptable.

2.10 SOURCE QUALITY CONTROL:

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements.

B. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 requirements.

C. Defective Work: Precast architectural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and finishes, are unacceptable. Replace with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Do not install precast concrete units until supporting masonry has attained minimum design compressive strength.

3.2 INSTALLATION:

A. General: Furnish units to mason Contractor for installation along with masonry as specified in a Division 4 section. Mason shall follow installation instructions herein with regard to Architectural Precast units.

B. Install clips, hangers, and other accessories required for connecting precast architectural concrete units to supporting members and backup materials.

C. Install precast architectural concrete. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.

1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.

D. Anchor precast architectural concrete units in position by bolting, welding, grouting, or as otherwise indicated. Remove temporary shims, wedges, and spacers as soon as possible after anchoring and grouting are completed.

E. Grouting 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. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

3.3 ERECTION TOLERANCES:

A. Install precast architectural concrete units level, plumb, square, and true, without exceeding the following noncumulative erection tolerances (Note that some may not apply to this Project).

1. Plan Location from Building Grid Datum: Plus or minus 1/8 inch.
2. Support Elevation from Nominal Support Elevation: As follows:

a. Maximum Low: 1/8 inch.
b. Maximum High: 1/8 inch.

3. Maximum Jog in Alignment of Matching Edges: 1/16 inch.

4. Joint Width (Governs over Joint Taper): Plus or minus 1/8 inch.
5. Maximum Jog in Alignment of Matching Faces: 1/16 inch.
6. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/16 inch.

3.4 FIELD QUALITY CONTROL:

A. Remove and replace work that does not comply with specified requirements.

3.5 REPAIRS:

A. Repair exposed exterior surfaces of precast architectural concrete units to match color, texture, and uniformity of surrounding precast architectural concrete if permitted by Architect.

B. Remove and replace damaged precast architectural concrete units if repairs do not comply with requirements.

3.6 CLEANING:

A. Clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt, and stains.

1. Wash and rinse according to precast concrete fabricator's written recommendations. 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.

END OF SECTION 03 45 00

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. Extent of each type of masonry work is indicated on drawings and schedule.

1.3 QUALITY ASSURANCE:

A. Fire-Resistance Rated Masonry: Comply with requirements for materials and installation established by governing authorities for the construction and fire-resistance rating indicated.

B. Construction Tolerances:

1. Variation from Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4 inch in 10 feet, or 3/8 inch in a story height not to exceed 20 feet, nor 1/2 inch in 40 feet or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4 inch in any story or 20 feet maximum, nor 1/2 inch in 40 feet or more.
2. Variation from Level: For lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4 inch in any bay of 20 feet maximum, nor 3/4 inch in 40 feet or more.
3. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2 inch in any bay or 20 feet maximum, nor 3/4 inch in 40 feet or more.
4. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4 inch nor plus 1/2 inch.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's specifications and other data for each type of masonry unit, accessory, and their manufactured products, including certifications that each type complies with specified requirements. Include instructions for handling, storage, installations and protection.

B. Samples:

1. For verification purposes submit the following:

a. Facing brick samples for each type of exposed brick required. Include in each set the full range of exposed color and texture to be expected in the completed work.
b. Colored masonry mortar samples for each color required showing the full range of color which can be expected in the finished work. Label samples to indicate type and amount of colorant used.

1.5 JOB CONDITIONS:

A. Protection of Work: During erection, cover top of walls with heavy waterproof sheeting at end of each days' work. Cover partially completed structures when work is not in progress.

B. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

C. Do not apply uniform floor or roof loading for at least 12 hours after building masonry walls or columns.

D. Do not apply uniform concentrated loads for at least 3 days after building walls or columns.

E. Staining: Prevent grout or mortar from staining the face of masonry to be left exposed or painted. Remove immediately grout or mortar in contact with such masonry.

F. Protect sills, ledges and projections from droppings of mortar.

G. Cold Weather Protection:

1. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
2. Remove all masonry determined to be frozen or damaged by freezing conditions.
3. Perform the following construction procedure while the work is progressing.

   a. When air temperature is from 40 degrees F to 32 degrees F, heat sand or mixing water to produce mortar temperature between 40 degrees F and 120 degrees F.
   b. When air temperature is from 32 degrees F to 25 degrees F heat sand or water to produce mortar temperature between 40 degrees F and 120 degrees F; maintain temperature of mortar on boards above freezing.
   c. When air temperature is from 25 degrees F to 20 degrees F, heat sand and mixing water to produce mortar temperatures between 40 degrees F and 120 degrees F; maintain temperature of mortar on boards above freezing; use salamanders or other heat sources on both sides of walls under construction; use wind breaks when wind is in excess of 15 mph.
   d. When air temperature is 20 degrees F and below, heat sand and mixing water to produce mortar temperatures between 40 degrees F and 120 degrees F; provide enclosures and auxiliary heat to maintain air temperature above 32 degrees F; do not lay units which have a surface temperature of 20 degrees F.

4. Perform the following protections for completed masonry and masonry not being worked on:

   a. When the mean daily air temperature is from 40 degrees F to 32 degrees F, protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.
   b. When mean daily air temperature is from 32 degrees F to 25 degrees F, completely cover masonry with weather-resistive membrane for at least 24 hours.
   c. When mean daily air temperature is from 25 degrees F to 20 degrees F, completely cover masonry with insulating blankets or similar protection for at least 24 hours.

d. When mean daily temperature is 20 degrees F and below, maintain masonry temperature above 32 degrees F for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps, or other acceptable methods.

PART 2 - PRODUCTS

2.1 BRICK:

A. Size: Unless otherwise indicated, provide nominal standard modular (4 inches x 2-2/3 inches x 8 inches) size brick.

1. For 3/8 inch joints, 3-5/8 inch x 2-1/4 inches x 7-5/8 inches manufactured size.

B. Facing Brick:

1. Provide Bowerston Shale Company, "Olde Cheyenne Modular."

2.2 CONCRETE MASONRY UNITS (CMU):

A. Size: Manufacturer's standard units with nominal face dimensions of 16 inches long x 8 inches (15-5/8 inches x 7 5/8 inches actual), unless otherwise indicated.

B. Special Shapes: Provide where required for lintels, corners, jambs, sash, control joints, headers, bonding and other special conditions.

C. Hollow Load-Bearing CMU: ASTM C 90, for general use in exterior walls above and below grade that may or may not be exposed to moisture penetration or the weather, and for interior walls and backup.

D. Hollow Nonload-Bearing CMU: ASTM C 129 .

E. Solid Load-Bearing CMU: ASTM C 145, provide Grade N.

F. Weight: Provide normal units using aggregate complying with ASTM C 33 producing dry net unit weight of not less than 125 lbs. per cu. ft., unless otherwise indicated.

G. Curing:

1. Cure unit in a moisture-controlled atmosphere or in an autoclave at normal pressure and temperature to comply with ASTM C 90, Type I. Limit moisture absorption during delivery and until time of installation to the maximum percentage specified for Type I units for the average annual relative humidity as reported by the U.S. Weather Bureau Station nearest the project site.

H. Exposed Faces:

1. Provide manufacturer's standard color and texture, unless otherwise indicated.
2. Match Architect's sample for color and texture.

I. Provide fire-rated units where rated walls are indicated.

2.3 MORTAR MATERIALS:

A. Portland Cement: ASTM C 150, Type I, except Type III may be used for cold weather construction.

1. Provide natural color or white cement as required to produce the required mortar color.

B. Masonry Cement: ASTM C 91.

C. Mortar Cement: ASTM C 1329.

D. Hydrated Lime: ASTM C 207, Type S.

E. Aggregates: ASTM C 144, except for joints less than 1/4 inch use aggregate graded with 100 percent passing the No. 16 sieve.

1. White Mortar Aggregates: Natural white sand or ground white stone.
2. Color Mortar Aggregates: Ground marble, granite or other sound stone, as required to match Architect's sample.

F. Colored Mortar Pigments: Commercial iron oxide, manganese dioxide, ultramarine blue, chromium oxide, or carbon black, compounded for use in mortar mixes. Do not exceed pigment-to-cement ratios, by weight of 1-to-35 for carbon black and 1-to-7 for other pigments.

1. Mortar Color: Light Grey to match existing mortar in brick veneers.

G. Water: Clean, free of deleterious materials which would impair strength or bond.

2.4 MASONRY ACCESSORIES:

A. Continuous Wire Reinforcing and Ties for Masonry:

1. Provide welded wire units prefabricated in straight lengths of not less than 10 feet, with matching corner and tee units. Fabricate from cold-drawn steel wire complying with ASTM A 82, with deformed continuous side rods and plain cross-rods, and a unit width of 1-1/2 inches to 2 inches less than thickness of wall or partition.
2. Provide units fabricated as follows:

a. Truss type fabricated with single pair of 9 gauge side rods and 9 gauge continuous diagonal cross-rods spaced not more than 16 inches on center.
b. Reinforcing shall be discontinuous at all movement joints.
c. For multi-wythed or cavity exterior walls with concrete masonry back-up fabricate units with additional side rods spaced for embedment in inside face of back-up wythe.
d. Tab type fabricated with single pair of 9 gauge rectangular box type cross-ties spaced not more than 16 inches on center. Space side rods for embedment in each face of back-up wythe and extend ties for proper embedment in facing wythe.
e. Provide units with adjustable 2-piece rectangular ties where horizontal joints of facing wythe do not align with back-up joints.

3. For interior walls, fabricate from mill galvanized wire.
4. For exterior walls, hot-dip galvanize after fabrication with 1.5 oz. zinc coating, ASTM A 153, Class B2.

B. Individual Wire Ties for Masonry:

1. Fabricate from 3/16 inch cold-drawn steel wire, ASTM A 82, unless otherwise indicated, of the length required for proper embedment in wythes of masonry.
2. For use with hollow masonry units laid cells vertical, provide rectangular shaped ties.
3. For use with solid masonry units, provide ties with ends bent to 90 degree angles to form hooks not less than 2 inches long. Where spacing and back-up joints do not align, provide either offset or adjustable 2-piece ties.
4. For interior walls, fabricate from steel wire with mill galvanized finish.
5. For exterior walls, fabricate from either AISI Series 300 stainless steel or hard-drawn copper wire, ASTM BI, except increase metal thickness approximately 20 percent for hard-drawn copper wire.
6. For exterior walls, fabricate from steel wire with 1.5 oz. hot-dip zinc coating, ASTM A 153 Class B 2, or fabricate from steel wire with not less than 7-mil copper coating, ASTM B 227, Grade 30 HS.

C. Anchors and Ties:

1. Provide straps, bars, bolts and rods fabricated from not less than 16 gauge sheet metal or 3/8 inch diameter rod stock, unless otherwise indicated.
2. Flexible Anchors: Where masonry is indicated to be anchored to structural framework with flexible anchors, provide 2-piece anchors, which will permit horizontal and vertical movement of masonry but will provide lateral restraint.
3. Masonry Veneer Anchors: Corrugated metal ties not less than 22 gauge and not less than 7/8 inch wide and 7 inches long with one end crimped for attachment to substrate. Size to extend to within 3/4 inch of face of masonry veneer.
4. Masonry Veneer Anchors (sheathing/stud back-up and soldier course): D/A 213 hot dip galvanized tie with D/A 808 self-drilling, self-taping, copolymer corrosion resistant coated screws. Manufactured by DUR-O-Wal, or Architect approved equal.
5. For interior work, including devices which extend only into interior wythes of exterior masonry, fabricate from steel with mill galvanized or hot-dip coating.
6. For devices which extend into exterior wythe, fabricate from Series 300 stainless steel or hard-drawn copper or bronze.
7. For devices which extend into exterior wythe, fabricate from steel with hot-dip galvanized coating, ASTM A 153, Class BI, B2, or B3.

D. Flashings for Masonry:

1. Provide concealed flashing, shown to be built into masonry.
2. Provide concealed flashings as follows:

    a. Stainless Steel: AISI Type 302/304, 2D finish, full annealed or dead-soft temper, 0.015 inch thick.
    b. Flashings shall lap a minimum of 4 inches.

E. Miscellaneous Masonry Accessories:

1. Reinforcing Bars: Deformed steel, ASTM A 615, Grade 60 of the sizes shown.
2. Metal Expansion Joint Strips: Provide the following formed to the shape shown.

    a. Stainless Steel: AISI Type 302/304 2D finish, fully annealed or dead-soft temper, 0.015 inch thick.

3. Bond Breaker Strips: 15-lb. asphalt roofing felt complying with ASTM D 226, or 15-lb, coal-tar roofing felt complying with ASTM D 227.

4. Premolded Control Joint Strips: Solid rubber strips with a Shore A durometer hardness of 60 to 80, designed to fit standard sash block and maintain lateral stability in masonry wall, size and configuration as indicated.
5. Weephole / Ventilators: One piece units made to fit in a vertical mortar joint from polyvinyl chloride in custom color approved by Architect to match mortar. Space at 24 inches on center at elevations shown. Williams Products, Inc., "Williams - Goodco Brick Vent" or Architect approved equal.
6. Mortar Netting: high density polyethylene (HDPE) or nylon strands woven into a 90% open mesh. To keep weep ventilators open, and suspends mortar droppings above the level of the flashing and weeps to prevent blockage of weeps. Mortar Net or Approved Equal

2.6 MORTAR AND GROUT MIXES:

A. Do not lower the freezing point of mortar by use of admixtures or antifreeze agents. Do not use calcium chloride in mortar or grout.

B. Portland Cement / Lime Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specifications, except limit materials to those specified herein, and limit cement/lime ratio (by volume) as follows:

1. Type M: 1/4 part lime per part of Portland cement.
2. Type S: Over 1/4 up to 1/2 part lime per part of Portland cement, for all load bearing walls.
3. Type N: Over 1/2 up to 1-1/4 parts lime per part of Portland cement, for exterior and interior non-load bearing walls.
4. Type O: over 1-1/4 up to 2-l/2 part lime per part of Portland cement.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

A. Thickness: Build masonry construction to the full thickness shown, except, build single-wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness shown or specified.

B. Build chases and recesses as shown and as required for the work of other trades. Provide not less than 8 inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

C. Cut masonry units with motor-driven saw designed to cut masonry with clean sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full units without cutting wherever possible.

D. Wet clay brick having ASTM C 67 absorption rate greater than 0.025 oz. per sq. in. per minute.

E. Do not wet concrete masonry units.

F. Frozen Materials and Work: Do not use frozen materials or materials mixed or coated with ice of frost. For masonry which is specified to be wetted, comply with the BIA recommendations. Do not build on frozen work. Remove and replace masonry work damaged by frost or freezing.

G. Pattern Bond: Lay exposed masonry in the bond pattern shown, or if not shown, lay in running bond vertical joint in each course centered on units in courses above and below. Lay concealed masonry with all units in a wythe bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners, unless otherwise shown. Match coursing, bonding, color and texture of new masonry work with existing work, where indicated.

H. Layout walls in advance for accurate spacing of surface bond patterns, with uniform joint widths and to properly locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half size units at corners, jambs and wherever possible at other locations.

I. Lay-up walls plumb and true and with courses level, accurately spaced and coordinated with other work.

J. Stopping and Resuming Work: Rack back 1/2-masonry unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if specified to be wetted), and remove loose masonry units and mortar prior to laying fresh masonry.

K. Built-In Work:

1. As the work progresses, build in items specified under this and other sections of these specifications. Fill in solidly with masonry around built-in items.
2. Fill space between hollow metal frames and masonry solidly with mortar.
3. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

L. Intersecting Load-Bearing Walls: If carried up separately, block vertical joint with 8 inches maximum offsets and provide rigid steel anchors spaced not more than 4 feet-0 inches o center vertically, or omit blocking and provide rigid steel anchors at not more than 2 feet-0 inches on center vertically. Form anchors of galvanized steel not less than 1-1/2 inches x 1/4 inch x 2 feet-0 inches long-with ends turned up not less than 2 inches or with cross-pins. If used with hollow masonry units, embed ends in mortar filled cores.

M. Nonbearing Interior Partition Walls: Build full height of story to underside of solid structure above, unless otherwise indicated.

3.2 MORTAR BEDDING AND JOINTING:

A. Use Type M mortar for masonry below grade and in contact with earth, interior and exterior loadbearing walls.

B. Use Type S mortar for exterior above grade loadbearing and nonload-bearing walls, parapet walls, pavements, and for interior loadbearing walls and nonload-bearing partitions.

C. Use Type O mortar for interior nonload-bearing partitions.

D. Batch Control:

1. Measure and batch materials either by volume or weight, such that the required proportions for mortar can be accurately controlled and maintained. Measurement of sand exclusively by shovel will not be permitted.
2. Mix mortars with the maximum amount of water consistent with workability to provide maximum tensile bond strength within the capacity of the mortar.

3. Mix mortar ingredients for a minimum of 5 minutes in a mechanical batch mixer. Use water clean and free of deleterious materials which would impair the work. Do not use mortar which has begun to set, or if more than 2-1/2 hours has elapsed since initial mixing. Retemper mortar during 2-1/2 hour period as required to restore workability.

E. Lay brick and other solid masonry units with completely filled bed, head and collar joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

F. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells; also bed webs in mortar in starting course on footings and foundation walls and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or to be filled with concrete or grout.

G. Joints: Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not otherwise indicated, lay walls with 3/8 inch joints. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials. Tool exposed joints slightly concave. Rake out mortar in preparation for application of caulking or sealants where shown.

H. Remove masonry units disturbed after laying; clean and relay in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove unit, clean off mortar, and reset in fresh mortar.

I. Collar Joints: Fill joints between wythes solidly with mortar by parging either the back of the facing, or the face of the backing, and shove units solidly into parging.

3.3 CAVITY WALLS:

A. Keep cavity clean of mortar droppings and other materials during construction. Strike joints facing cavity, flush.

B. Tie exterior wythe to back-up with individual metal ties spaced not more than 16 inches on center vertically and 24 inches on center horizontally. Stagger in alternate courses.

C. Tie exterior wythe to back-up with continuous horizontal joint reinforcing embedded in mortar joints at not more than 16 inches on center vertically.

D. Provide weep holes in exterior wythe of cavity, composite and veneer walls located immediately above ledges and flashing, spaced 2 feet-0 inches on center, unless otherwise indicated.

3.5 HORIZONTAL JOINT REINFORCING:

A. Provide continuous horizontal joint reinforcing as shown and specified. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls and 1/2 inch at other locations. Lap reinforcement a minimum of 6 inches at ends of units. Do not bridge control and expansion joints with reinforcing, as otherwise indicated. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

B. Space continuous horizontal reinforcing as follows:

1. For multi-wythe walls (solid or cavity) where continuous horizontal reinforcing also acts as structural bond or tie between wythe, space reinforcing as required by code but not less than 16 inches on center vertically.
2. For single-wythe walls, space reinforcing at 16 inches on center vertically, unless otherwise indicated.
3. For parapets, space reinforcing at 8 inches on center vertically, unless otherwise indicated.

C. Reinforce masonry openings greater than 1 foot- 0 inches wide, with horizontal joint reinforcing placed in 2 horizontal joints approximately 8 inches apart, both immediately above the lintel and below the sill. Extend reinforcing a minimum of 2 feet-0 inches beyond jambs of the opening, bridging control joints where provided.

3.6 ANCHORING MASONRY WORK:

A. Provide anchoring devices of the type shown or as specified. If not shown or specified, provide standard type for facing and back-up involved.

B. Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:

1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise shown. Keep open space free of mortar or other rigid materials.
2. Anchor masonry to structural members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible tie sections, unless otherwise indicated.
3. Space anchors as shown, but not more than 24 inches on center vertically and 36 inches on center horizontally.

3.7 LINTELS:

A. Install loose lintels of steel and other materials where shown.

B. Provide masonry lintels where shown and wherever openings of more than 1 foot-0 inches are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Thoroughly cure precast lintels before handling and installation. Temporarily support formed-in-place lintels.

C. For hollow concrete masonry unit walls, use specially formed "U"-shaped lintel units with reinforcing bars placed as shown and filled with Type M mortar or concrete grout.

D. Provide minimum bearing at each jamb, of 4 inches for openings less than 6 foot-0 inches wide, and 8 inches for wider openings.

3.8 CONTROL AND EXPANSION JOINTS:

A. Provide vertical expansion, control and isolation joints in masonry where shown. Build-in related masonry accessory items as the masonry work progresses.

1. See Division 7 sections for "Joint Sealers."
2. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of flow. Seal joints below grade and at junctures with horizontal expansion joints, if any.
3. Build-in flanges of factory-fabricated expansion joint units, specified in a Division 7 section.

4. Build-in joint fillers where shown, specified in a Division 7 section.

B. Control Joint Spacing: If location of control joints is not shown, place vertical joints spaced not to exceed 35 feet-0 inches on center for concrete masonry wythes if reinforced, or 30 feet-0 inches on center if not reinforced.

3.9 FLASHING OF MASONRY WORK:

A. Provide concealed flashings in masonry work at, or above, all shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior. Prepare masonry surfaces smooth and free from projections, which could puncture flashing. Place through-wall flashing on bed of mortar and cover with mortar. Seal penetrations in flashing with mastic before covering with mortar.

1. Extend flashings the full length of lintels and shelf angles and minimum of 4 inches into masonry each end. Extend flashing from a line 1/2 inch in from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4 inches, and through the inner wythe to within 1/2 inch of the interior face of the wall in exposed work. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2 inches.
2. Provide weepholes in the head joints of the same course of masonry bedded in the flashing mortar.
3. Interlock end joints of deformed metal flashings by overlapping deformations not less than 1-1/2 inches and seal lap with elastic sealant.
4. Install flashings in accordance with manufacturer's instructions.

B. Install reglets and nailers for flashing and other related work where shown to be built into masonry work.

3.10 REPAIR, POINTING AND CLEANING:

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints at corners, openings and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.

C. Clean exposed brick masonry surfaces by the bucket and brush hand cleaning method or by high pressure water method.

D. Use commercial cleaning agents in accordance with manufacturer's instructions.

E. Clean exposed CMU masonry by dry brushing at the end of each day's work and after final pointing to remove mortar spots and droppings.

END SECTION 04 20 00

SECTION 05 12 00 - STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Extent of structural steel work is shown on drawings including schedules, notes and details to show size and location of members, typical connections and type of steel required.
2. Structural steel is that work defined in AISC "Code of Standard Practice" and as otherwise shown on drawings.

B. Related Sections:

1. Miscellaneous Metal Fabrications are specified elsewhere in Division 5.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges."
2. AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings," including the "Commentary" and Supplements thereto as issued.
3. AISC "Specifications for Architecturally Exposed Structural Steel."
4. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
5. AWS D1.1 "Structural Welding Code."
6. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

B. Qualifications for Welding Work:

1. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."
2. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests within previous 12 months. If recertification of welders is required, retesting will be Contractor's responsibility.

1.4 SUBMITTALS:

A. Product Data: If requested, submit producer's or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.

B. Shop Drawings:

1. Submit shop drawings prepared under supervision of a registered professional engineer, including complete details and schedules for fabrication and assembly of structural steel members procedures and diagrams.
2. Include details of cuts, connections, camber, holes and other pertinent data. Indicate welds by standard AWS symbols and show size, length and type of each weld.
3. Provide setting drawings, templates and directions for installation of anchor bolts and other anchorages to be installed by others.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not delay that work.

B. Store materials to permit easy access for inspection and identification. Keep steel members off the ground using pallets, platforms or other supports. Protect steel members and packaged materials from erosion and deterioration.

C. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Metal Surfaces, General: For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding or by welding and grinding, prior to cleaning, treating and application of surface finishes.

B. Rolled Wide-Flange Steel Shapes: ASTM A 992, with Fy = 50 ksi minimum

C. Other Structural Steel Shapes, Plates and Bars: ASTM A 36, except where other type steel is indicated.

D. Cold-Formed Steel Tubing (HSS – square, rectangular and round): ASTM A 500, Grade B, with Fy = 46 ksi minimum.

E. Steel Pipe: ASTM A 53, Type E or S, Grade B.

1. Finish: Black, except where indicated to be galvanized.

F. Anchor Bolts: ASTM F 1554, nonheaded type unless otherwise indicated.

G. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low carbon steel bolts and nuts. Provide either hexagonal or square, heads and nuts, except use only hexagonal units for exposed connections.

H. High Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts and hardened washers, as follows:

1. Quenched and tempered medium carbon steel bolts, nuts and washers, complying with ASTM A 325. For high strength low alloy steel, provide Type 3 fasteners of similar composition as members to be connected.
2. Direct tension indicating ("twist-off") bolts, as manufactured by Lejeune, Nucor or equal and conforming to the above, are acceptable.
3. Quenched and tempered alloy steel bolts, nuts and washers, complying with ASTM A 490.

I. Electrodes for Welding: Comply with AWS Code. For high strength low alloy steel, provide electrodes, welding rods and filler metals equal in strength and compatible in appearance with parent metal joined.

J. Shear Connectors/Stud Anchors
Headed studs for embedment in concrete or masonry shall be manufactured from cold-drawn bar stock conforming to ASTM A-108, as manufactured by TRW, Nelson Division.

K. Structural Steel Primer Paint: Equal to Tnemec, Series 88HS, except for architecturally exposed to exterior, use one shop coat equal to Tnemec 90-97, Zinc-rich Urethane.

L. Nonmetallic Shrinkage Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-C588, Type A.

1. Products offered by manufacturers to comply with requirements for nonmetallic, nonshrink grout include following:

a. Euco N.S.; Euclid Chemical Company
b. Crystex; L&M Construction Chemicals
c. Masterflow 713; Master Builders
d. Five Star Grout; U.S. Grout Corp.
e. Upcon; Upco Chem. Div., USM Corp.
f. Propak; Protex Industries, Inc.

2.2 FABRICATION:

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.

B. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence, which will expedite erection and minimize field handling of materials.

C. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs and other defects.

D. Connections:

1. Weld or bolt shop connections, as indicated.
2. Bolt field connections, except where welded connections or other connections are indicated.
3. Provide high strength threaded fasteners for principal bolted connections, except

where unfinished bolts are indicated.

4. Provide unfinished threaded fasteners for only bolted connections of secondary framing members to primary members (including purlins, girts and other framing members taking only nominal stresses) and for temporary bracing to facilitate erection.

E. High Strength Bolted Construction: Install high strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts." (RCRBSJ).

F. Welded Construction:

1. Comply with AWS Code for procedures, appearance and quality of welds and methods used in correcting welding work.
2. Assemble and weld built-up sections by methods which will produce true alignment of axis without warp.
3. For high strength low alloy steels, follow welding procedures as recommended by steel producer for exposed and concealed connections.

G. Holes for Other Work:

1. Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on final shop drawings.
2. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work.
3. Cut, drill or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.3 SHOP PAINTING:

A. General: Shop paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel, which is partially exposed on exposed portions, and initial 2 inches of embedded areas only.

1. Do not paint surfaces which are to be welded or high strength bolted with friction type connections.
2. Do not paint surface which are scheduled to receive sprayed-on fireproofing.
3. Do not paint surfaces of exposed high strength low alloy steel members.
4. Apply 2 coats of paint to surfaces which are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

B. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council as follows:

1. SSPC – SP1 "Solvent Cleaning."
2. SSPC – SP2 "Hand Tool Cleaning."
3. SSPC – SP3 "Power Tool Cleaning."

C. Painting: Immediately after surface preparation apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide a minimum uniform dry film thickness of 2.0 mils. Use painting methods which result in full coverage of joints, corners, edges and exposed surfaces.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Erector must examine areas and conditions under which structural steel work is to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Erector.

3.2 ERECTION:

A. Surveys: Establish permanent bench marks as shown and as necessary for accurate erection of structural steel. Check elevations of concrete and masonry bearing surfaces and locations of anchor bolts and similar devices before erection work proceeds and report discrepancies to Architect. Do not proceed with erection until corrections have been made or until compensating adjustments to structural steel work have been agreed upon with Architect.

B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

C. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.

D. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations.

E. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

F. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

G. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials and allow to cure.

H. Field Assembly:

1. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
2. Level and plumb individual members of structure within specified AISC tolerances.
3. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed

and in service.

4. Splice members only where indicated and accepted on shop drawings.

I. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.

J. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment and removal of paint on surfaces adjacent to field welds.

K. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

L. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to Architect. Finish gas cut sections equal to a sheared appearance when permitted.

M. Stud/Shear Connector Welding:

1. Remove any paint on surfaces to receive studs.
2. Use ONLY automatically timed stud welding equipment, as manufactured by TRW, Nelson Division, following all manufacturer's recommendations.
3. Adjust equipment on trial studs as necessary until sound anchorages are obtained.

N. Hand operated shielded metal arc welding of studs will NOT be permitted.Touch Up Painting: Immediately after erection clean field welds, bolted connections and abraded areas of shop paint. Apply paint to exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

END SECTION 05 12 00

SECTION 05 20 00 - METAL JOISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. Extent of steel joists is shown on drawings including basic layout and type of joists required.

1.3 QUALITY ASSURANCE:

A. Provide joists fabricated in compliance with the following and as herein specified:

1. SJI "Standard Specifications, Load Tables and Weight Tables" for:

a. K-Series Open Web Steel Joists

B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with the AWS "Standard Qualification Procedure."

C. Fabrication and erection shall comply with the Occupational Safety and Health Administration (OSHA) standards for the Construction Industry, including 2001 requirements of 29 CFR 1926 Part R Safety Standards for Steel Erection.

1.4 JOIST DESIGN:

A. Design all joists for a maximum live load deflection of L/360.

B. Design bridging for roof joists for a net uplift of 8 psf.

1.5 SUBMITTALS:

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of joist and accessories. Include manufacturer's certification that joists comply with SJI "Specifications."

B. Shop Drawings: Submit detailed drawings showing layout of joist units, special connections, jointing and accessories. Include mark, number, type, location and spacing of joists and bridging. Shop drawings shall be prepared, sealed, signed, and dated by a Wisconsin registered Professional Engineer.

C. Provide templates or location drawings for installation of anchor bolts.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Deliver, store and handle steel joists as recommended in SJI "Specification." Handle and store joists in a manner to avoid deforming members and to avoid excessive stresses.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Steel: Comply with SJI "Specifications."

B. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular hexagon type, low carbon steel.

B. High Strength Threaded Fasteners: ASTM A 325 or A 490 heavy hexagon structural bolts with nuts and hardened washers.

C. Steel Prime Paint: Comply with SJI "Specifications," except asphalt type paint not permitted.

2.2 FABRICATION:

A. General: Fabricate steel joists in accordance with SJI "Specification."

B. Holes in Chord Members: Provide holes in chord members where shown for securing other work to steel joists; however, deduct area of holes from the area of chord when calculating strength of member.

C. Extended Ends: Provide extended ends on joists where shown, complying with manufacturer's standards and requirements of applicable SJI "Specifications" and load tables.

D. Bridging:

1. Provide horizontal or diagonal type bridging for "open web" joists, complying with SJI "Specifications."
2. Provide diagonal type bridging for "longspan" joists, complying with SJI "Specifications."
3. Provide bridging anchors for ends of bridging lines terminating at walls or beams.

E. Shop Painting: Remove loose scale, heavy rust and other foreign materials from fabricated joists and accessories before application of shop paint. Apply one shop coat of primer paint to steel joists and accessories by spray, dipping or other method to provide a continuous dry paint film thickness of not less than 1.0 mil.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Erector must examine areas and conditions under which steel joists are to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Erector.

3.2 ERECTION:

A. Place and secure steel joists in accordance with SJI "Specifications," final shop drawings and as herein specified.

B. Placing Joists: Do not start placement of steel joists until supporting work is in place and secured. Place joists on supporting work, adjust and align in accurate locations and spacing before permanently fastening.

1. Provide temporary bridging, connections and anchors to ensure lateral stability during construction.
2. Where "open web" joist lengths are 40 foot and longer, install a center row of bolted bridging to provide lateral stability before slackening of hoisting lines.

C. Bridging: Install bridging simultaneously with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams.

D. Fastening Joists:

1. Field weld joists to supporting steel framework in accordance with SJI "Specifications" for type of joists used. Coordinate welding sequence and procedure with placing of joists.
2. Secure joists resting on masonry or concrete bearing surfaces by bedding in mortar and anchoring to masonry or concrete construction as specified in SJI "Specifications" for type of steel joist used.
3. Bolt joists to supporting steel framework in accordance with SJI "Specifications" for type of joists used.
4. Provide unfinished threaded fasteners for bolted connections, unless otherwise indicated.

E. Touch Up Painting: After joist installation paint field bolt heads and nuts and welded areas, abraded or rusty surfaces on joists and steel supporting members. Wire brush surfaces and clean with solvent before painting. Use same type of paint as used for shop painting applied to achieve a minimum dry film thickness of 1.0 mil.

END SECTION 05 20 00

SECTION 05 30 00 - METAL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. The extent of metal decking is shown on the drawings, including basic layout and type of deck units required.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of the following codes and standards, except as otherwise shown or specified:

1. AISI "Specification for the Design of Cold-Formed Steel Structural Members".
2. AWS "Structural Welding Code".
3. SDI "Design Manual for Floor Decks and Roof Decks".

B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

1.4 PERFORMANCE REQUIREMENTS:

A. Uplift Loading: Install and anchor roof deck units to resist gross uplift loading of 45 pounds per square feet at eave overhang and 30 pounds per square feet for other roof areas.

1.5 SUBMITTALS:

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of decking and accessories. Include manufacturer's certification as may be required to show compliance with these specifications.

B. Shop Drawings: Submit detailed drawings showing layout and types of deck panels, anchorage details, and conditions requiring closure panels, supplementary framing, sump pans, cant strips, cut openings, special jointing or other accessories.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Steel for Painted Metal Deck Units: ASTM A 611, Grade C.

B. Miscellaneous Steel Shapes: ASTM A 36.

C. Sheet Metal Accessories: ASTM A 526, commercial quality, galvanized.

D. Paint: Manufacturer's baked-on, rust-inhibitive paint, for application to metal surfaces which have been chemically cleaned and phosphate chemical treated.

E. Powder-actuated Fasteners: Fasteners, appropriately sized for substrate thickness, equal to Hilti, for installation with the DX 750 system.

F. Pneumatically attached Fasteners: Fasteners, appropriately sized for substrate thickness (maximum 3/8"), equal to Hilti.

2.2 FABRICATION:

A. General: Form deck units in lengths to span 3 or more supports, with flush, telescoped or nested 2 inch laps at ends and interlocking or nested side laps, unless otherwise indicated.

B. Roof Deck Units: Provide deck configurations complying with SDI "Roof Deck Specifications", of metal thickness, depth and width as shown.

C. Open-Beam Metal Floor Deck Units: Provide fluted sections of metal thickness, depth and width as shown.

D. Metal Cover Plates: Fabricate metal cover plates for end-abutting floor deck units of not less than same thickness as decking. Form to match contour of deck units and approximately 6 inches wide.

E. Metal Closure Strips: Fabricate metal closure strips, for cell raceways and openings between decking and other construction, of not less than 0.045 inch min. (18 gage) sheet steel. Form to provide tight-fitting closures at open ends of cells or flutes and sides of decking.

F. Roof Sump Pans: Fabricate from single piece of 0.071 inch minimum (14 gage) galvanized sheet steel with level bottoms and sloping sides to direct water flow to drain, unless otherwise shown. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 3 inches wide. Recess pans not less than 1-1/2 inches below roof deck surface, unless otherwise shown or required by deck configuration. Holes for drains will be cut in the field.

G. Cant Strips: Fabricate cant strips of 0.028 inch minimum (22 gage) galvanized sheet steel. Bend to form a 45 degree cant not less than 5 inches wide, with top and bottom flanges not less than 2 inches wide, unless otherwise shown.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer must examine areas and conditions under which metal decking is to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION:

A. General:

1. Install deck units and accessories in accordance with manufacturer's recommendations and final shop drawings, and as specified herein.
2. Place deck units on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks.
3. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.
4. Do not place deck units on concrete supporting structure until concrete has cured and is dry.
5. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
6. Do not use floor deck units for storage or working platforms until permanently secured.

B. Fastening Deck Units:

1. Fasten floor deck units to steel supporting members by not less than 5/8 inch diameter fusion welds or elongated welds of equal strength, spaced not more than 12 inches on center with a minimum of 2 welds per unit at each support.

    a. Tack weld or use machine screws at 4 feet-0 inches on center for fastening end closures.

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

C. Joint Covers: Provide metal joint covers at abutting ends and changes in direction of floor deck units, except where taped joints are required.

D. Roof Sump Pans: Place over openings provided in roof decking and weld to top decking surface. Space welds not more than 12 inches on center with at least one weld at each corner. Cut opening in roof sump bottom to accommodate drain size indicated.

E. Cant Strips: Weld to top surface of roof decking, and secure to wood nailers with galvanized nails, and to steel framing with welds or galvanized self-tapping screws. Space fasteners or welds at 12 inches on center. Lap end joints not less than 3 inches, and secure with galvanized sheet metal screws.

F. Closure Strips:

1. Provide metal closure strips at open uncovered ends and edges of roof decking, and in voids between decking and other construction. Weld into position to provide a complete decking installation.

G. Touch Up Painting:

1. After decking installation, wire brush, clean and paint scarred areas, welds and rust spots on top and bottom surfaces of decking units and supporting steel members.
2. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.
3. In areas where shop painted surfaces are to be exposed, apply touch up paint to blend into adjacent surfaces.

END SECTION 05 30 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. Extent of light gage framing is shown on drawings.

B. Types of light gage metal framing units include the following:

1. "C" shaped steel studs.
2. "C" shaped steel joists.

1.3 QUALITY ASSURANCE:

A. Component Design: Structural design of the light gauge materials is necessary only in so far as to provide proper clips/connections between members and base materials. Compute structural properties of these accessories in accordance with AISI "Specification for Design of Cold-Formed Steel Structural Members" and Center for Cold-Formed Steel Structures (CCFSS) Technical Bulletin, Vol. 2, No. 1, February 1993 "AISI Specification Provisions for Screw Connections".

B. Studs listed on drawings are the sizes required for fit-out of the project.

C. Headers and jambs at openings may consist of built-up cold-formed metal sections, as determined by the cold-formed framing designer. Some

D. Welding: Use qualified welders and comply with the American Welding Society (AWS) D1.3, "Structural Welding Code Sheet Steel." Welders shall be currently certified in the State of Wisconsin, in accordance with Section 6.0 "Inspection" of AWS D1.3. and per the stipulations of the Wisconsin Department of Commerce.

E. Manufacturers offering products complying with requirements for light gage metal framing components include the following:

1. "C"-shaped load bearing studs, 1-5/8 inch flange:

   a. Clark-Western Building Systems
   b. Dietrich Metal Framing
   c. Marino/WARE

2. "C"-shaped steel joists:

   a. Clark-Western Building Systems
   b. Dietrich Metal Framing
   c. Marino/WARE

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's product information and installation instructions for each item of light gage framing and accessories.

B. Shop Drawings:

1. Submit shop drawings for special components and installations not fully dimensioned or detailed in manufacturer's product data.

2. Include placing drawings for framing members showing size and gage designations, number, type, location and spacing. Indicate supplemental strapping, bracing, splices, accessories, and details required for proper installation.

1.5 DELIVERY AND STORAGE:

A. Protect metal framing units from rusting and damage. Deliver to project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade. Store off ground in a dry ventilated space or protect with suitable waterproof coverings.

PART 2 - PRODUCTS

2.1 METAL FRAMING:

A. System Components: With each type of metal framing required, provide manufacturer's standard steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories as recommended by manufacturer for applications indicated, as needed to provide a complete metal framing system.

B. Materials and Finishes:

1. For 16 gage and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 40,000 psi; ASTM A 653.

2. For 18 gage and lighter units, fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi; ASTM A 653.

3. Provide galvanized finish to metal framing components complying with ASTM A 653 for minimum G 90 coating.

C. "C" Shape Studs: Manufacturer's standard load-bearing steel studs of size, shape, and gage indicated, with 1.625 inches flange and flange return lip.

D. Joists: Manufacturer's standard C shape sections of size, shape and gage indicated.

2.2 FABRICATION:

A. General: Framing components may be prefabricated into panels prior to erection. Fabricate panels plumb, square, true to line and braced against racking with joints welded. Perform lifting of prefabricated panels in a manner to prevent damage or distortion.

B. Fastenings:

1. Attach similar components by welding. Attach dissimilar components by welding, bolting, or screw fasteners, as standard with manufacturer.

2. Wire tying of framing components is not permitted.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION:

A. Preinstallation: Prior to start of installation of metal framing systems, meet at project site with installers of other work including door and window frames and mechanical and electrical work. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.

3.2 INSTALLATION:

A. Manufacturer's Instructions: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations, unless otherwise indicated.

B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed 24 inches on center spacing for nail or power-driven fasteners, nor 16 inches on center for other types of attachment. Provide fasteners at corners and ends of tracks.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.

E. Install supplementary framing, blocking and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.

F. Installation of Wall Stud System: Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.

G. Frame wall openings larger than 2 feet-0 inches square with double stud at each jamb of frame except where more than 2 are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure stud system wall opening frame in manner indicated.

H. Install horizontal stiffeners in stud system, space (vertical distance) at not more than 4 feet-6 inches on center. Weld at each intersection.

I. Installation of Joists:

1. Install level and plumb, complete with bracing and reinforcing as indicated on drawings. Provide not less than 1-1/2 inches end bearing.

2. Reinforce ends with end clips, steel hangers, steel angle clips, steel stud section, end grain wood block, or as otherwise recommended by joist manufacturer.

3. Secure joists to interior support systems to prevent lateral movement of bottom flange.

J. Field Painting: Touch up shop-applied protective coatings damaged during handling and installation. Use galvanizing repair paint for galvanized surfaces.

END SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Loose bearing and leveling plates.
2. Loose steel lintels.
3. Miscellaneous framing and supports.
4. Bar-stock Ladders
5. Shelf Angles

B. Related Sections:

1. Structural steel is specified in another section within Division 5.
2. Finish painting of steel fabrications in a Division 9 Section.

1.3 QUALITY ASSURANCE:

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

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

1.4 SUBMITTALS:

A. Shop Drawings:

1. Submit shop drawings for fabrication and erection of miscellaneous metal fabrications. Include plans, elevations and details of sections and connections. Show anchorage and accessory items. Provide templates for anchor and bolt installation by others.
2. Where materials or fabrications are indicated to comply with certain requirements for design loadings include structural computations, material properties and other information needed for structural analysis.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Metals:

1. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
2. Steel Plates, Shapes and Bars: ASTM A 36.
3. Structural Steel Sheet: Hot rolled, ASTM A 570 or cold rolled ASTM A 611, Class 1; of grade required for design loading.
4. Galvanized Structural Steel Sheet: ASTM A 653/A, of grade required for design loading.
5. Steel Pipe: ASTM A 53; Type and grade (if applicable) as selected by fabricator and as required for design loading; black finish unless galvanizing is indicated; standard weight (schedule 40), unless otherwise indicated.
6. Brackets, Flanges and Anchors' Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

B. Grout:

1. Nonshrink Nonmetallic Grout: Premixed, factory packaged, nonstaining, noncorrosive, nongaseous grout complying with CE CRD-C588. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.

C. Fasteners: (As Required)

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

D. Primer Paint:

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

2.2 FABRICATION, GENERAL:

A. Workmanship:

1. Use materials of size and thickness shown or, if not shown, of required size and thickness to produce strength and durability in finished product. Work to dimensions shown or accepted on shop drawings, using proven details of

fabrication and support. Use type of materials shown or specified for various components of work.

2. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise shown. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
3. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
4. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type shown or, if not shown, Phillips flat-head (countersunk) screws or bolts.
5. Provide for anchorage of type shown, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
6. Cut, reinforce, drill and tap miscellaneous work as indicated to receive finish hardware and similar items.

B. Galvanizing:

1. Provide a zinc coating for those items shown or specified to be galvanized, as follows:

   a. ASTM A 153 for galvanizing iron and steel hardware.
   b. ASTM A 123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed and forged shapes, plates, bars and strip 22 gage, 0.0299 inch thick, or thicker.

2. Fabricate joints which will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.

C. Shop Painting:

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

2.3 MISCELLANEOUS METAL FABRICATIONS:

A. Rough Hardware:

1. Furnish bent or otherwise custom bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting

woodwork and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 sections.

2. Manufacturer or fabricate items of sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

B. Bar-stock Ladders:

1. Fabricate ladders for the locations shown, with dimensions, spacings, details and anchorages as indicated. Comply with the requirements of ANSI A14.3, except as otherwise indicated.

   a. Unless otherwise shown, provide 1/2 inch x 2-1/2 inches continuous structural steel flat bar side rails with eased edges, space 18 inches apart.
   b. Provide 3/4 inch diameter solid structural steel bar rungs, spaced 12 inches on center.

2. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.
3. Support each ladder at top and bottom and at intermediate points spaced not more than 5 feet-0 inches on center. Use welded or bolted steel brackets, designed for adequate support and anchorage and to hold the ladder clear of the wall surface with a minimum of 7 inches clearance from wall to centerline of rungs. Extend rails 42 inches above top rung and return rails to wall or structure unless other secure handholds are provided. If the adjacent structure does not extend above the top rung, gooseneck the extended rails back to the structure to provide secure ladder access.
4. Provide all necessary brackets and fittings for installation.

   a. Galvanize ladders, brackets and fasteners where indicated.

C. Loose Bearing and Leveling Plates:

1. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanized after fabrication.
2. Weld Plates for Roof Joists: Provide 7 inches x 1/4 inch x 0 feet-7 inch weld plates with on 3/4 inch x 5 inches headed stud.

D. Loose Steel Lintels:

1. Provide loose structural steel lintels for openings and recesses in masonry walls and partitions as shown. Weld adjoining members together to form a single unit where indicated. Provide not less than 8 inches bearing at each side of openings, unless otherwise shown.
2. Galvanized loose steel lintels to be installed in exterior walls.
3. Provide loose steel lintels over exterior and interior openings including openings for mechanical work such as louvers, heating units, ventilators, sheet metal ducts, grilles, unless otherwise indicated. Bear 8 inches unless otherwise indicated. Provide all angles, lintels as required for all built-in items and openings.
4. Provide lintels as follows unless otherwise indicated:

Wall Thickness	Span to 4 Feet	Span 4 to 7 Feet
4"	(1) 3-1/2"x3-1/2"x5/16"	(1) 3-1/2"x3-1/2"x5/16
6"	(1) WT4 x 6.5	(1) WT4 x 6.5
8"	(2) 3-1/2"x3-1/2"x5/16"	(2) 4"x3-1/2"x5/16"
12"	(3) 3-1/2"x3-1/2"x5/16"	(3) 4"x3-1/2"x5/16"

E. Miscellaneous Framing and Supports:

1. Provide miscellaneous steel framing and supports which are not a part of structural steel framework, as required to complete work.
2. Fabricate miscellaneous units to sizes, shapes and profiles shown or, if not shown, of required dimensions to receive adjacent work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
3. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.

    a. Except as otherwise shown, space anchors 24 inches on center and provide minimum anchor units 1-1/4 inches x 1/4 inch x 8 inches steel straps.

4. Galvanize miscellaneous frames and supports where indicated.

F. Miscellaneous Steel Trim:

1. Provide shapes and sizes for profiles shown. Except as otherwise noted, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work.
2. Galvanized miscellaneous steel trim where indicated.

G. Steel Pipe Railings and Handrails:

1. Fabricate railings of 1-1/4 inches nominal diameter standard steel pipe (1.660 O.D.). Space posts not more than 6 feet-0 inches on center unless otherwise indicated.
2. Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator's option, except as otherwise indicated.

    a. At tee and cross intersections provide coped joints.
    b. At bends interconnect pipe by means of prefabricated elbow fittings or flush radius bends, as applicable, or radiuses indicated.
    c. At elbow bends provide mitered joints.
    d. Form bends by use of prefabricated elbow fittings and radius bends or by bending pipe, at fabricator's option.

3. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting or otherwise deforming exposed surfaces of pipe.
4. Provide wall returns at ends of wall mounted handrails, except where otherwise indicated.

5. Close exposed ends of pipe by welding 3/16 inch thick steel plate in place or by use of prefabricated fittings.
6. Toe Boards: Where indicated, provide toe boards at railings around openings and at the edge of open-sided floors and platforms. Fabricate to the dimension and details shown, or if not shown, use a 4 inches high x 1/8 inch plate welded to and centered between each railing post.
7. Brackets, Flanges, Fittings and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings and anchors for interconnection of pipe and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connection railings and handrails to concrete or masonry work.
8. Galvanize exterior steel railing and interior steel railings where shown, including pipe, fittings, brackets, fasteners and other ferrous components. Provide black steel pipe for interior railings not indicated otherwise.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.2 INSTALLATION:

A. General:

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

B. Setting Loose Plates:

1. Clean concrete and masonry bearing surfaces of any bond reducing materials and roughen to improve bond surfaces. Clean bottom surface of bearing plates.
2. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims; but if protruding, cut off flush with

the edge of the bearing plate before packing with grout. Use metallic nonshrink grout in concealed locations where not exposed to moisture; use nonmetallic nonshrink grout in exposed locations, unless otherwise indicated.

3. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

C. Setting Loose Lintels:

4. Place lintels with bearing distance at each end as shown; if not shown provide minimum bearing of 8 inches at each end. In hollow core c.m.u. walls, grout solid the core or cores directly under the lintel bearing areas for a depth of at least one course or tooth in a solid unit.

D. Steel Pipe Railings and Handrails:

1. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated, or if not indicated, as required by design loadings. Plumb post in each direction. Secure posts and railing ends to building construction as follows.

   a. Anchor posts in concrete by core drilling holes not less than 5 inches deep and 3/4-inch greater than outside diameter of post. Clean holes of all loose material, insert posts and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's directions.
   b. Cover anchorage joint with a round steel flange welded to post.
   c. Anchor posts to steel with steel oval flanges, angle type or floor type as required by conditions, welded to posts and bolted to steel supporting members.
   d. Anchor rail ends into concrete and masonry with steel round flanges welded to rail ends and anchored into wall construction with lead expansion shields and bolts.
   e. Anchor rail ends to steel with oval or round flanges welded to rail ends and bolted to structural steel members, unless otherwise indicated.
   f. Provide removable railing sections as indicated. Furnish slip-fit metal socket or sleeve for casting concrete. Accurately locate sleeves to match post spacing.

2. Secure handrails to wall with wall brackets and end fittings. Provide bracket with not less than 1-1/2 inches clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required for design loading. Secure wall brackets and wall return fittings to building construction as follows:

   a. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
   b. For concrete and solid masonry anchorage, use drilled-in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.
   c. For hollow masonry anchorage, use toggle bolts having square heads.
   d. For stud partitions use lag bolts set into wood backing between studs. Coordinate with stud installation for accurate location of backing members.

3.3 ADJUST AND CLEAN:

A. Touch Up Painting: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. For Galvanized Surfaces: Clean field welds, bolted connections and abraded areas and apply 2 coats of galvanized repair paint, according to ASTM A 780.

END SECTION 05 50 00

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following.

1. Wood grounds, nailers, and blocking.
2. Wood Decking.
3. Glass Mat Gypsum Sheathing.

B. Related Sections:

1. Finish carpentry is specified in another Division-6 section.
2. Architectural Woodwork is specified in another Division-6 section.

1.3 REFERENCES:

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

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

1.4 SUBMITTALS:

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

1. Glass mat gypsum sheathing.
2. Plywood decking.

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

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

1. Pressure Treatment: For each type specified, include certification by treating plant stating chemicals and process used, net amount of preservative retained and conformance with applicable standards.

2. For waterborne preservatives include statement that moisture content of treated materials was reduced to a maximum of 15 percent prior to shipment to project site.
3. Fire-Retardant Treatment: Include certification by treating plant that treatment material complies with governing ordinances and that treatment will not bleed through finished surfaces.

1.5 PRODUCT HANDLING:

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

1.6 PROJECT CONDITIONS:

A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of other work.

B. Provide fire treated nailers, panels, blocking, grounds and sleepers in all locations necessary to comply with code requirements for applicable class of construction.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Plywood:

1. Trademark: Identify each plywood panel with appropriate APA trademark.
2. Concealed Performance Rated Plywood: Where plywood panels will be used for the following concealed types of applications, provide APA Performance Rated Panels complying with requirements indicated for grade designation, span rating, exposure durability classification, edge detail (where applicable) and thickness.

a. Roof Sheathing: APA RATED SHEATHING.

1) Exposure Durability Classification: EXTERIOR.
2) Span Rating: As required to suit rafter spacing indicated.

3. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant treated plywood panels with grade designation, APA C-D PLUGGED INT with exterior glue, in thickness indicated or, if not otherwise indicated, not less than 1/2 inch.

B. Glass Mat Gypsum Sheathing: Provide 1/2 inch (for 16 inches on center framing) 5/8 inch (for 24 inches on center framing) thick gypsum board complying with ASTM C 1177 and the following:

1. Water-repellent treated core with water absorption of less than 10 percent by weight after 2 hour immersion (ASTM C 473), and fiberglass surface on face and back.
2. Sizes and Edges: 4 feet wide, not less than 8 feet long, with square edges on sides.
3. "Dens-Glass Gold" by Georgia Pacific Corporation or equal.

C. Miscellaneous Materials:

1. Fasteners and Anchorages: Provide size, type, material and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommending nails. Where rough carpentry work is exposed to weather, in ground contact, associated with roofing work, or in areas of high relative humidity provide fasteners and anchorages with a hot-dip zinc (ASTM A 153).
2. Polyethylene Vapor Retarder:

   a. ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.13 perm.

3. Vapor Retarder Tape:

   a. Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.2 WOOD TREATMENT:

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

1. Pressure-treat above ground items with waterborne preservatives to a minimum retention of 0.25 pound/cubic foot. After treatment, kiln dry lumber and plywood to a maximum moisture content of 19 percent and 15 percent respectively. Treat indicated items and the following:

   a. Wood cants, nailers, curbs, blocking, stripping and similar members in connection with roofing, flashing, vapor barriers and waterproofing.
   b. Wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry or concrete.
   c. Wood framing members less than 18 inches above grade.

2. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces.

B. Fire-Retardant Treatment: Where "FR-S" lumber or plywood is specified or otherwise indicated provide materials which comply with AWPA standards for pressure impregnation with fire-retardant chemicals and which have a flame spread rating of not more than 25 when tested in accordance with UL Test 723 or ASTM E 84 and show no increase in flame spread and significant progressive combustion upon continuation of test for additional 20 minutes.

1. Where treated items are exposed on exterior or to high humidities or are to have a transparent finish in form of stain or sealer, provide materials which show no change in fire-hazard classification when subjected to standard rain test (UL 790 or ASTM B 2898).
2. Use fire-retardant treatment which will not bleed through or adversely affect type of finish indicated and which does not require brush treatment of field made end cuts to maintain fire-hazard classification.

3. Where transparent finish is indicated use type of treatment and species which permits milling of lumber after treatment without altering indicated fire-hazard classification, as determined by fire testing.
4. Kiln dry treated items to maximum moisture content of 19 percent.
5. Provide UL label on each piece of fire-retardant lumber or plywood.

C. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General:

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

B. Wood Nailers and Blocking:

1. Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
2. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

C. Installation of Plywood:

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

   a. Decking: Screw to metal framing.
   b. Plywood Backing Panels: Nail or screw to supports.

D. Glass Mat Gypsum Wall Sheathing:

1. General: Provide glass mat gypsum board sheathing where shown. Fasten to exterior face of steel stud framing for exterior walls. Use manufacturers recommended fasteners not more than 4 inches on center around perimeter and 8 inches on center at intermediate supports. Keep perimeter fasteners 3/8 inch

from edges and ends of board units. Fit boards tightly against each other and around openings.

2. Install 2 foot x 8 foot sheathing horizontally with long edges at right angles to studs with grooved edge down. Center end joints over supports and stagger in each course. Screw to each support in accordance with manufacturer's recommended spacing, but provide not less than 4 fasteners per 2 foot width per stud if framing is diagonally braced or not less than 7 fasteners per 2 foot width per stud if not braced.

3. Install 4 foot x 8 foot or longer sheathing vertically with long edges parallel to and centered over studs. Provide solid wood blocking wherever end joints do not bear against framing sills or plates. Screw to each support in accordance with manufacturer's recommended spacing, but space fasteners not more than 4 inches on center around perimeter at edge and end supports and 8 inches on center at intermediate supports.

4. Seal all joints in glass mat gypsum wall sheathing and trowel flat. Apply sealant over every fastener to cover completely, then trowel flat.

E. Miscellaneous: Lap joints of vapor barrier and weather resistive barrier in direction of water flow, lapped a minimum of 2 inches with all joints taped or sealed

END SECTION 06 10 00

SECTION 06 20 13 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. This Section includes the following:

1. Exterior Pergola Framing.

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.

1.4 SUBMITTALS

A. Product Data: For each type of product and grade. Include construction and application details.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect materials against weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.1 MATERIALS GENERAL

A. Lumber: DOC PS 20 and the following grading rules:

1. WWPA: Western Wood Products Association, "Western Lumber Grading Rules."

B. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.

2.2 DIMENSION LUMBER FRAMING

A. Dimension Lumber and Board Trim for Opaque Stained Finish Applications:

1. Dimension Lumber Species and Grade: Western Red Cedar, Grade B; NLGA, WCLIB, or WWPA.
2. Maximum Moisture Content: 19 percent.
3. Finger Jointing: Not allowed.

4. Face Surface: Surfaced (smooth).

2.3 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.

1. For Cedar, provide stainless-steel or hot-dip galvanized steel fasteners.

2.4 FABRICATION

A. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut exterior finish carpentry to fit adjoining work.
2. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
3. Coordinate exterior finish carpentry with materials and systems in or adjacent to it.

3.4 DIMENSION LUMBER FRAMING INSTALLATION

A. Install flat grain lumber with bark side exposed to weather.

B. Install trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long except where necessary.

1. Use scarf joints for end-to-end joints.
2. Stagger end joints in adjacent and related members.

C. Fit exterior joints to exclude water. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

D. Unless otherwise indicated, countersink fasteners, fill surface flush, and sand where face fastening is unavoidable.

3.5 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

A. Clean exterior finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.7 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 06 20 13

SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Running and standing trim including:

a. Trim for window sills.

2. Casework with transparent finish.
3. Plastic laminate countertops.
4. Plastic laminate faced shelving.
5. Solid surface material.

B. Related Sections:

1. Blocking in walls for casework is specified within another section of Division 6.
2. Wood Doors are specified within Division 8.

1.3 QUALITY ASSURANCE:

A. Quality Standards: Except as otherwise shown or specified, comply with specified provisions of the following:

1. Architectural Woodwork Institute (AWI) "Quality Standards."

B. AWI Quality Marking: Mark each assembled unit of architectural woodwork with manufacturer's identification and grade mark evidencing compliance with indicated AWI quality grade. Locate grade mark on surfaces which will not be exposed after installation. For other items requiring field assembly, a certification of compliance may be substituted for marking of individual pieces.

1.4 REFERENCES:

A. AWI Quality Standard: Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI), except as otherwise indicated.

1.5 SUBMITTALS:

A. Product Data: Submit manufacturer's specifications and installation instructions for each item of factory fabricated woodwork.

1. Certification: Include certification that treated materials comply with governing regulations.
2. Quality Certification: Submit manufacturer's (Fabricator's) certification stating that the fabricated work meets the woodwork grade(s) specified.

B. Shop Drawings: Submit shop drawings showing location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components. Submit shop drawings for the following:

1. Casework.
2. Shelving.
3. Solid Surface components.

C. Samples: Submit the following samples for each species and cut or pattern of architectural woodwork:

1. Solid wood for transparent finish; set of 3 pieces, 6 inches x 3/4 inch x 18 inches, for each species, finished on one side and one edge.
2. Plywood or veneer for transparent finish, 3 finished samples, 12 inches square, for each species and cut.
3. Solid wood, plywood or particleboard with factory applied opaque finish, 12 inches square, for each finish system and color.
4. Exposed cabinet hardware, one unit of each type and finish.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Protect woodwork during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

B. Do not deliver woodwork, until painting, wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas. If due to unforeseen circumstances woodwork must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

1.7 JOB CONDITIONS:

A. Conditioning: Installer shall advise Contractor of temperature and humidity requirements for woodwork installation areas. Do not install woodwork until required temperature and relative humidity have been stabilized and will be maintained in installation areas.

B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed woodwork within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. The fabricator of woodwork shall determine optimum moisture content and required temperature and humidity condition.

PART 2 - PRODUCTS

2.1 BASIC MATERIALS AND FABRICATION METHODS:

A. General: Except as otherwise indicated, comply with following requirements for architectural woodwork not specifically indicated as prefabricated or prefinished standard products.

B. Wood Moisture Content: Provide kiln dried lumber with an average content range of 6 percent to 11 percent for interior work. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed the following:

1. Interior Wood Finish: 5 percent-10 percent for mild regions (as defined by AWI).

C. Interior Wood for Transparent Finish:

1. Solid Wood: Rift sawn Red Oak.
2. Plywood: Rift cut Red Oak.

D. Wood Veneer Panel Casework Substrate:

1. Medium density fiberboard ANSI A208.2

E. Wood Veneer Panel Faces:

1. AWI Veneer Grade A.
2. Veneer thickness: 1/42" minimum before sanding.

F. Plastic Laminate: Comply with NEMA LD-3; type, thickness, color, pattern and finish as indicated for each application.

G. Plastic Laminate Substrate:

1. Medium density fiberboard ANSI A208.2
   or
   45# density particleboard ANSI A208.1, Grade M-3.

H. Quality Standards: For following types of architectural woodwork; comply with indicated standards as applicable:

1. Standing and Running Trim: AWI Section 300.
2. Countertops: AWI Section 400.
3. Shelving: AWI Section 600.

I. Design and Construction Features: Comply with details shown for profile and construction of architectural woodwork; and where not otherwise shown, comply with applicable Quality Standards with alternate details as Fabricator's option.

J. Precut Openings: Fabricate architectural woodwork with precut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing-in diagrams for proper size and shape. Smooth edges of cutoffs and where located in countertops and similar exposures seal edges of cutouts with a water resistant coating.

K. Measures: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain measurements and verify dimensions and shop drawing details as required for accurate fit. Where sequence of measuring substrates before fabrication would delay the project, proceed with fabrication (without field measurements) and provide ample borders and edges to allow for subsequent scribing and trimming of woodwork for accurate fit.

2.2 INTERIOR ARCHITECTURAL WOODWORK:

A. Standing and Running Trim

1. Grade: Custom.
2. Fabricate standing and running trim including sills to dimensions, profiles and details shown. Rout or groove reverse side (backed out) of trim members to be applied to flat surface, except for members with ends exposed in finish work.
3. Plant assemble miters unless otherwise indicated.

B. Wood Casework, Transparent Finish:

1. Grade: Custom, except Premium Grade drawer construction.
2. Construction: Full overlay.
3. Provide dust panels of 1/4 inch thick plywood or tempered hardboard above compartments and drawers, except where located directly below countertops.

C. Plastic Laminate Countertops:

1. General: Except as otherwise indicated, provide separate plastic laminate countertops (installed on other casework or other support system as indicated) to comply with requirements for casework for plastic laminate finish.

    a. Plastic Laminate for Horizontal Surfaces: 0.050 inch thick, GeneralPurpose Type (high pressure).

2. Grade: Premium.
3. Finish of Plastic Laminate: Refer to "Schedule Of Interior Finishes" in the drawings.

D. Storage Shelving- Plastic Laminate Finish:

1. General: These requirements do not apply to shelving which is either integral with or indicated as "casework"; comply with casework requirements for those units of shelving.
2. Grade: Custom.
3. Core Construction: Plywood.
4. Fabricate exposed edges of shelves, including edges with matching plastic laminate, except as otherwise indicated.
5. Finish of Plastic Laminate: Refer to "Schedule Of Interior Finishes" in the drawings.

E. Solid surface Material for Counter Tops and Vanities:

a. Approved Manufacturers are:

    a. Avonite
    b. DuPont, Corian
    c. Formica Solid Surfacing
    d. Nevamar
    e. Vendura
    f. WilsonArt
    g. Approved Equal

b. Kitchen Counter Tops:

    a. Nominal Thickness: 1 inch.
    b. Provide 4 inch high, integral back and side splashes.

c. Depth of top: As indicated.
d. Color: Refer to the Schedule of Interior Finishes.
e. Obtain template for fittings and sink and coordinate cutouts for same.

c. Vanity Tops:

a. Nominal Thickness: 1 inch.
b. Vanity Sink: Solid surface bowl of same material as top, ADA-compliant design for under mounting, with integral overflow.
c. Shape and size: Oval, with approximate inside dimensions of 16" x 13" x 5 1/2" deep, equal to Corian #810.
d. Overflow location: provide an offset overflow inlet and piping if vanity has a front panel that would be obstructed by an overflow at the front of bowl.
e. Provide 4 inch high, integral back and side splashes.
f. Color: Match top, or if not available in matching color, as selected by Architect.

F. Solid surface Material for Shower Stalls:

a. Approved Manufacturers are:

a. Trillium
b. Approved Equal

b. Shower Floors:

a. Standard design with raised curb and ADA-compliant design, as indicated on Drawings
b. Prepared to receive floor drain by Plumbing contractor.

c. Shower Walls:

a. Solid panels adhered to substrate.

2.3 FINISH FOR ARCHITECTURAL WOODWORK:

A. General: The entire finish of architectural woodwork is work of this section, regardless of whether shop applied or applied after installation.

B. Shop Finishing: To the greatest extent possible, finish architectural woodwork at shop or factory. Defer only final touch up, cleaning and polishing for time after delivery and installation.

C. General: The priming and prefinishing (if any) of architectural woodwork required to be performed at the shop or factory is specified as work of this section. Refer to Division 9 sections for final finishing of installed architectural woodwork.

D. Preparations for Finishing: Comply with AWI Quality Standards, Section 01500, for sanding, filling countersunk fasteners, back priming and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.

E. Transparent Finish:

1. General Finish Standard: AWI Finish System No. 3, Premium Grade, open grain finish.
2. Shop Application: Stain and sealer (match approved sample for color).

3. Final Finish: Sanding, followed by 2 coats of clear alkyd-urea conversion varnish, rubbed to medium sheen.

2.4 CABINET HARDWARE AND ACCESSORY MATERIALS:

A. General: Provide cabinet hardware and accessory materials associated with architectural woodwork, except for units which are specified as "door hardware" in other sections of these specifications.

B. Hardware Standards: Except as otherwise indicated, comply with ANSI A156.9 "American National Standard for Cabinet Hardware."

1. Quality Level: Type 2 (institutional), unless otherwise indicated.
2. Quality Certification: Where available, provide cabinet hardware bearing the BHMA certification label, affixed either to hardware or its packaging, showing compliance with BHMA Cabinet Hardware Standard 201.

C. Cabinet Door Hardware: Provide hinges, catches and pulls of types indicated, to properly accommodate each door size and style.

D. Exposed Hardware Finish: Except where not available, provide exposed hardware with BHMA Code 626 satin chromium plate finish (US26D); where not available, provide either satin aluminum or satin stainless steel finish.

E. Drawer Hardware: Provide slides and pulls of types indicated, to properly accommodate each drawer size and style.

1. Equip each drawer with side mounted, full extension, ball bearing type, nylon roller drawer slides.
2. Equip deep utensil drawers with side mounted, full extension, extra-heavy-duty ball bearing type, nylon roller drawer slides.

F. Shelf Supports: Where shelving is indicated inside casework, as "adjustable" provide shelf support adjustable system:

1. Standard 32mm system holes.
2. Double pin, clear, locking shelf support. Constructed of injection molded polycarbonate resin with screw slot and integral snap latch to prevent shelf uplift of 3/4" or 1" shelving.
3. Must comply with Grade 3 requirements per the ANSI/BHMA A156.9-2003 specification. Able to withstand load levels to 300 pounds.

G. Exposed Hinges:

1. Haefele, AxiMat 300 Single Pivot Institutional Hinge for full overlay door:

a. Grade: ANSI/BHMA, Grade 1.
b. Swing: 270 degrees.
c. Single cup.
d. Premounted expanding Dowels.
e. Finish: Matte nickel.
f. Provide number of hinges based on manufacturer's recommendations.

H. Cabinet door bumpers:

1. Self-adhesive 100% polyeurethane.

2. Transparent color.
3. Containing UV inhibitors to prevent yellowing over time.
4. UL 94 HB Approved
5. Identical to Haefele No. 356.25.405

I. Pulls: (US 26D finish).

1. Approved products:
MC-402-4; Epco
4483; Stanley Hardware

PART 3 - EXECUTION

3.1 PREPARATION:

A. Condition woodwork to average prevailing humidity conditions in installation areas prior to installing.

B. Preinstallation Meeting: Meet at project site prior to delivery of architectural woodwork and review coordination and environmental controls required for proper installation and ambient conditioning in areas to receive work. Include in meeting the Contractor; Architect and other Owner Representative (if any); installers of architectural woodwork, wet work such as plastering, other finishes, painting, mechanical work and electrical work; and firms or persons responsible for continued operation (whether temporary or permanent) of HVAC system as required to maintain temperature and humidity conditions. Proceed with woodwork installation only when everyone concerned agrees that required ambient conditions can be properly maintained.

C. Deliver concrete inserts and similar anchoring devices to be built into substrates well in advance of time substrates are to be built.

D. Prior to installation of architectural woodwork, examine shop fabricated work for completion and complete work as required including back priming and removal of packing.

3.2 INSTALLATION:

A. Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8 inch in 8 feet-0 inches for plumb and level (including countertops); and with 1/16 inch maximum offset in flush adjoining surfaces, 1/8 inch maximum offsets in revealed adjoining surfaces.

B. Scribe and cut work to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

C. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns, miter at corners and comply with Quality Standards for joinery.

D. Anchor woodwork to anchors or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

E. Casework: Install without distortion so that doors and drawers will fit openings properly and be accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated. Maintain veneer sequence matching (if any) of casework with transparent finish.

F. Countertops: Anchor securely to base units and other support systems as indicated.

G. Wood Storage Shelving: Complete the assembly of units and install in the areas indicated, including hardware and accessories as indicated.

3.3 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION:

A. Repair damaged and defective woodwork wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace woodwork. Adjust joinery for uniform appearance.

B. Clean hardware, lubricate and make final adjustments for proper operation.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop applied finishes to restore damaged or soiled areas.

D. Complete the finishing work specified as work of this section, to whatever extent not completed at shop or prior to installation of woodwork.

E. Refer to the Division 9 sections for final finishing of installed architectural woodwork.

F. Protection:

1. Installer of architectural woodwork shall advise Contractor of final protection and maintained conditions necessary to ensure that work will be without damage or deterioration at time of acceptance.
2. Cover completed work with 4 mil polyethylene film protective enclosure, applied in a manner which will allow easy removal and without damage to woodwork or adjoining work. Remove cover immediately before time of final acceptance.

END SECTION 06 40 23

SECTION 06 64 05 - FIBERGLASS REINFORCED PLASTIC PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Fiberglass reinforced plastic wall panels and associated trim.

1.3 SUBMITTALS:

A. Product Data: Submit product data on panels, adhesives and associated trim accessories.

B. Samples: Submit samples of panels and trim. Submit samples of colors available for color selection.

1.4 PROJECT CONDITIONS:

A. Field Measurements: Verify dimensions by field measurements.

1.5 DELIVERY AND STORAGE OF MATERIALS:

A. Lay panels flat. Do not store on concrete surface. Do not store on edge.

B. Damaged and deteriorated materials shall be removed from the premises.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers:

Kemlite: Fire-X Glasbord.
Nudo: Fiber-Lite Liner Panels.
Sequentia: 77136 Fire Retardant Wall Panels.

2.2 MATERIALS:

A. Panels: Panels shall be fiberglass reinforced plastic panels with a Class "A" rating. The surface of the panel facing the space shall have a textured finish. Panels shall be USDA accepted for incidental food contact. Color as selected by Architect from Manufacturer's standard colors available.

B. Panel Thickness: .090 inches thick.

C. Trim/Moldings: Shall be one or two piece non-staining vinyl extruded moldings for use at panel edges, corners, and butt joints. Moldings shall match panels in color.

D. Adhesive: Manufacturer's standard for substrate encountered.

E. Sealants: Manufacturer's standard silicone based sealant.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Inspect substrate material. Substrate shall be flat, clean, dry, and free of all dirt, dust or grease.

3.2 INSTALLATION:

A. Install panels and trim per manufacturer's instructions. Make appropriate allowances for expansion and contraction of materials. Adhere panels to substrate. No exposed fasteners will be allowed.

B. Set trim and panel joints with a bead of sealant to seal the joint.

END SECTION 06 64 05

SECTION 07 14 16 - COLD FLUID-APPLIED WATERPROOFING

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. Latex-rubber waterproofing.

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:

1. Show locations and extent of waterproofing.
2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

C. Qualification Data: For Installer.

1.2 QUALITY ASSURANCE

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

1.3 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.

1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.
2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing 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 LATEX-RUBBER WATERPROOFING

A. Two-Component, Unreinforced, Latex-Rubber Waterproofing: ASTM C 836/C 836M; coal-tar free.

1. Products: Subject to compliance with requirements,:

a. Grace Construction Products; W.R. Grace & Co. -- Conn; Procor.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated acrylic latex, polyurethane, or epoxy.

C. Sheet Flashing: 50-mil-minimum, nonstaining, uncured sheet neoprene.

1. Adhesive: Manufacturer's recommended contact adhesive.

D. Membrane-Reinforcing Fabric: Manufacturer's recommended fiberglass mesh or polyester fabric,.

E. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

F. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; ASTM C 920, Type M, Class 25 or greater; Grade NS for sloping and vertical applications and Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.

1. Backer Rod: Closed-cell polyethylene foam.

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 Work.

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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 1471.

B. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 1471. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Comply with ASTM C 1193 for joint-sealant installation.
2. Apply bond breaker on sealant surface, beneath preparation strip.
3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches wide along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

3.5 WATERPROOFING APPLICATION

A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C 1471.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 60 mils.
2. Apply waterproofing to prepared wall terminations and vertical surfaces.
3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft..

E. Cure waterproofing, taking care to prevent contamination and damage during application and curing.

3.6 PROTECTION

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END SECTION 07 14 16

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. Extent of insulation work is shown on drawings, by generic names or by abbreviations.

B. Applications of insulation specified in this section include the following:

1. Insulation under slabs-on-grade.
2. Foundation wall insulation (supporting backfill).
3. Block/board cavity wall insulation.
4. Blanket-type building insulation.

1.3 RELATED WORK OF OTHER SECTIONS:

A. Applications of insulation specified in other sections include the following:

1. Insulation related to E.I.F.S. system is specified in another Division 7 section.
2. Roof insulation is specified in another Division 7 section.
3. Acoustic insulation related to wall systems is specified in a Division 9 section.

1.4 QUALITY ASSURANCE:

A. Thermal Conductivity: Thicknesses shown are for thermal conductivity (k-value at 75 degrees F) specified for each material. Provide adjusted thicknesses as directed for equivalent use of material having a different thermal conductivity. Where insulation is identified by "R" value, provide appropriate thickness.

B. Fire and Insurance Ratings: Comply with fire-resistance, flammability and insurance ratings indicated, and comply with governing regulations as interpreted by authorities.

C. Installer: Installer of foamed-in-place insulation shall be only a firm approved by manufacturer of primary foaming materials.

1.5 SUBMITTALS:

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of insulation required.

B. Test Reports: Submit laboratory test report on each frothed or foamed-in-place insulation sample, indicating required test results, general location of work represented by sample, and date of sample.

1.6 PRODUCT HANDLING:

A. General Protection: Do not allow insulation materials to become wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.

B. Protection for plastic insulation:

1. Do not expose to sunlight.
2. Protect against ignition at all times. Do not deliver plastic insulating materials to project site ahead of installation time. Complete installation and concealment of plastic materials as rapidly as possible in each area of work.

PART 2 - PRODUCTS

2.1 MATERIALS:

B. Extruded Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation with closed-cells and integral high density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C 578 for type indicated; with 5-year aged R-values of 5.4 and 5 at 40 and 75 degrees F, respectively; and as follows:

1. Type IV, 1.60 lb/cu. ft., perimeter foundation walls.
2. Type VI, 1.80 lb/cu. ft., underslab.
3. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 75 and 450, respectively.

C. Mineral/Glass Fiber Blanket/Batt Insulation: Inorganic fibers formed into flexible resilient blankets or semirigid resilient sheets; ASTM C 665; density as indicated, but 1.0 lb minimum; k-value of 0.27; manufacturer's standard lengths and widths as required to coordinate with spaces to be insulated; types as follows:

1. Approved manufacturers are:

a. Owens-Corning Fiberglass
b. Johns-Manville
c. Rockwool Industries
d. U.S. Gypsum
e. Thermafiber Inc
f. Flame Spread Rating: 25 (ASTM E 84) for foil facing.

2. Facing Types:

a. Type I: Unfaced unit; semirigid where required for self-support.
b. Type II: Nonreflective facing with integral nailing flanges; 1.0 perm rating, other face (if any) permeable.
c. Type III: Reflective aluminum foil facing with integral nailing flanges; 1.0 perm rating, other face (if any) permeable.

D. Miscellaneous Materials:

1. Adhesive for Bonding Insulation: Type recommended by insulation manufacturer and complying with fire-resistance requirements.
2. Mechanical Anchors: Type and size shown or, if not shown, as recommended by insulation manufacturer for type of application and condition of substrate.
3. Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints between units and filling voids in work.

4. Polyethylene Vapor Retarder: ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.13 perm.
5. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joint and penetrations in vapor retarder.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer must examine substrate and conditions under which insulation work is to be performed and must notify Contractor in writing of unsatisfactory conditions. Do not proceed with insulation work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 PREPARATION:

A. Close off openings in cavities to receive poured-in-place and foamed-in-place insulation, sufficiently to prevent escape of insulation.

3.3 INSTALLATION:

A. General:

1. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with work.
2. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.
3. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

B. Perimeter and Underslab Insulation:

1. On vertical surfaces, set units in adhesive applied in accordance with manufacturer's instructions. Use type adhesive recommended by manufacturer of insulation.
2. Protect insulation on vertical surfaces (from damage during backfilling) by application of protection course board. Set in adhesive in accordance with recommendations of manufacturer of insulation.
3. Protect top surface of horizontal insulation (from damage during concrete work) by application of protection course board.

C. Cavity-Wall Insulation:

1. On units of plastic insulation where not fastened by furring system, install small pads of mortar or mastic spaced approximately 1 foot-0 inches on center both ways on inside face, as recommended by manufacturer. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
2. Seal joints between closed-cell (non-breathing) insulation units by applying mastic or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with mastic or sealant.

SECTION 07 24 00 - EXTERIOR INSULATION AND FINISH SYSTEM - CLASS PB

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Insulation, acrylic plaster application over glass mat faced gypsum sheathing substrate and associated accessories.

B. Related Sections:

1. Glass mat gypsum sheathing is specified in a Division 6 Section.
2. Sealants are specified in another Division 7 Section.

1.3 QUALITY ASSURANCE:

A. Application of system shall be by manufacturer's approved applicator following manufacturer's instructions.

B. Design Criteria: All system materials shall be designed to resist a wind load of 20 pounds per square foot with a live load deflection not to exceed L/240.

C. Allowable Tolerances: System shall meet the required dimensions as indicated $\pm$ 3/16 inch.

D. Brittle products, which must be panelized such as polymer modified systems, are not acceptable.

E. Single Source Responsibility: Obtain materials for system from one source and by a single manufacturer or by manufacturers approved by the system manufacturer as compatible with other system components.

1.4 PERFORMANCE REQUIREMENTS:

A. General: Provide systems that comply with the following performance requirements:

1. Bond Integrity: Free from bond failure within system components or between system and supporting wall construction, resulting from exposure to fire, wind loads, weather, or other in-service conditions.
2. Weathertightness: Resistant to water penetration from exterior into system and assemblies behind it or through them into interior of building that results in deterioration of thermal-insulating effectiveness or other degradation of system and assemblies behind system, including substrates, supporting wall construction, and interior finish.

B. Physical Properties of Class PB: Provide exterior insulation and finish systems whose physical properties and structural performance comply with the following requirements when tested per methods referenced:

1. Accelerated Weathering Characteristics: Sample of size suitable for test equipment and consisting of 1-inch thick exterior insulation system mounted on 1/2 inch thick gypsum board, cured for 28 days, shows no evidence of cracking, flaking, or deleterious effects after testing for 2,000 hours per Method 1 of ASTM G 23.
2. Water Penetration: Sample, consisting of 1 inch thick exterior insulation and finish system mounted on 1/2 inch thick gypsum board, cured for 28 days, shows no water penetration into the plane of the innermost face of the test specimen under 2.86 psf of air pressure difference across the specimen during a 15-minute test period when tested per ASTM E 331.
3. Water Resistance: Sample, consisting of 1 inch thick exterior insulation and finish system mounted on 1/2 inch thick board, cured for 28 days, shows no deleterious effects after testing for 14 days per ASTM D 2247.
4. Absorption-Freeze Resistance: Three samples, 4 by 8 by 1 inch in size, consisting of exterior insulation and finish system coated on all sides with base and finish coats including reinforcing fabric, cured for 28 days, show no visible change when subjected to 4 days' underwater soak followed by 60 cycles of alternating exposure for 2 hours minus 10 degrees C and 2 hours to plus 20 degrees C.
5. Mildew Resistance: Sample, consisting of finish coat applied to 2 by 2 inch clean glass substrate, cured for 28 days, shows no mildew growth when tested per MIL Standard 810C, Method 508.
6. Abrasion Resistance: Sample, consisting of 1 inch thick exterior insulation and finish system mounted on 1/2 inch thick gypsum board, cured for a minimum of 28 days, shows no evidence of cracking, checking, or loss of film integrity after exposure to 500 liters of sand when tested per ASTM D968, Method A.
7. Impact Resistance: Sample, consisting of 1 inch thick exterior insulation and finish system when constructed, conditioned, and tested per EIMA 101.86, produces the following impact classification and range:

    a. Standard Impact Resistance: 25-49 inch-lb.

8. Negative Wind Load Performance: Sample assembly, 48 by 48 inches in size, consisting of studs, sheathing, and 1 inch thick exterior insulation and finish system, shows capability to withstand wind loads indicated when tested per ASTM E 330.
9. Fire-Test-Response Characteristics: Provide materials and construction that are identical to those tested with the following fire-test-response characteristics, as determined by testing per ASTM test method indicated below, by UL or other testing and inspecting agencies acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting agency.

    a. Flame Spread of Insulation Board and Finish Coats: 25 or less when tested individually per ASTM E 84.
    b. Smoke Developed of Insulation Board and Finish Coats: 450 or less when tested individually per ASTM E 84.

1.5 SUBMITTALS:

A. Product Data: Submit manufacturer's product specifications and installation instructions for each component of system, including other data as may be required to show

compliance with these specifications.

B. Product test reports from a qualified independent testing agency evidencing compliance of exterior insulation and finish systems with requirements based on comprehensive testing of current products.

C. Shop drawings showing fabrication and installation of system including plans, elevations, sections, details of components, joint locations and configurations within system and between systems and construction penetrating it, and attachments to construction behind system.

D. Installer certificates signed by manufacturer certifying that Installers comply with requirements under the "Quality Assurance" Article.

E. Samples for verification in the form of 24-inch square panels for each finish, color, texture, and pattern specified. Prepare samples using same tools and techniques intended for actual work.

1.6 PRODUCT HANDLING:

A. Deliver products in original, unopened packages with manufacturer's labels identifying products legible and intact.

B. Store materials inside and under cover; keep them dry and protected from the weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, damage from construction traffic, and other causes.

1. Stack insulation board flat and off the ground.

1.7 JOB CONDITIONS:

A. Environmental Conditions: Do not install system when ambient outdoor air and substrate temperatures are 40 degrees F and falling unless temporary protection and heat are provided to maintain ambient temperatures above 40 degrees F during installation of wet materials and until they have dried thoroughly and become weather resistant, but for not less than 24 hours after installation.

B. Protect contiguous work from soiling, spattering, moisture deterioration and other harmful effects, which might result from plastering.

C. Protect finished work when stopping for the day or when completing an area in order that water will not penetrate behind the system.

D. Coordination: Cap flashing and sealant shall be installed as soon as possible after the installation of the system to avoid water penetration.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Manufacturers: Subject to compliance with requirements, available manufacturers providing products that may be incorporated into the Work include, but are not limited to, the following:

1. BASF Wall Systems.

2. Corev America, Inc.
3. Dryvit Systems, Inc.
4. Master Wall, Inc.
5. Omega Products International, Inc.
6. Parex USA, Inc.
7. Sto Corp.
8. Total Wall, Inc.

2.2 MATERIALS:

A. Compatibility: Provide adhesive, board insulation, reinforcing fabrics, base and finish coat materials, sealants, and accessories that are compatible with one another and approved for use by system manufacturer.

B. Primer-Sealer: System manufacturer's standard substrate conditioner designed to seal substrates from moisture penetration and to improve the bond between substrate of type indicated and adhesive used for application of insulation, as recommended by manufacturer.

C. Rigid Insulation:

1. Molded Polystyrene Board Insulation: Rigid cellular thermal insulation formed by the expansion of polystyrene beads or granules in a closed mold, complying with ASTM C 578 for Type I, approved by system manufacturer for material qualities including corner squareness and other dimensional tolerances, and the following:

a. Age insulation in block form prior to cutting and shipping by air drying for not less than 6 weeks or by another method approved by system manufacturer that produces equivalent results.
b. Provide insulation in boards not more than 24 by 48 inches and in thickness indicated but not less than allowed by system manufacturer, nor more than 4 inches.

D. Adhesive/Base Coat: Acrylic based. Factory-mixed formulation designed for adhesive attachment of insulation to substrates of type indicated and for base coat application over insulation, as approved by system manufacturer.

E. Mechanical Fasteners: System manufacturer's standard corrosion resistant fastener assemblies, complete with system manufacturer's standard washer and shaft attachments, selected for properties of pull-out, tensile and shear strength required to resist design. For attachment to masonry and concrete substrates, provide sheathing dowel in the form of plastic wing tipped fastener with thermal cap, sized to fit insulation thickness indicated and penetrate substrate to depth required to secure anchorage. Countersink head of fastener and plug hole for thermal break.

F. Reinforcing Fabric: Balanced, alkali-resistant open-weave glass-fiber fabric treated for compatibility with other system materials, made from continuous multiend strands with tensile strength of not less than 145 lb and 150 lb in warp and fill directions per ASTM D 5035, complying with ASTM D 578 and the following requirements for minimum weight:

1. Standard Reinforcing Fabric: Not less than 4.3 oz./sq. yd.
2. Intermediate Reinforcing Fabric: Not less than 10 oz./sq. yd.
3. Impact-Resistant (Armor) Reinforcing Fabric: Not less than 20 oz./sq. yd.
4. Strip Reinforcing Fabric: Not less than 3.75 oz./sq. yd.
5. Corner Reinforcing Fabric: Not less than 7.2 oz./sq. yd.

G. Base and Finish: Acrylic based (100 percent minimum) synthetic high bonding plaster with permanent integral color and applied texture providing a weatherproof jointless exterior surface, ASTM C150, Type 1. Texture to be selected by Architect from manufacturer's standards. Color to match sample paint chips.

H. Control Joints and Reveal Joints: Install in accordance with manufacturer's standard details and recommendations and as located on the drawings. At reveals do not reduce insulation thickness to less than 1-inch.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas to receive exterior insulation and finish system for deviations from contract documents which will adversely effect installation.

B. Do not start work until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS:

A. Protect contiguous work from moisture deterioration and soiling resulting from application of systems. Provide temporary covering and other protection needed to prevent spattering of exterior finish coatings on other work.

B. Protect system, substrates, and wall construction behind them from inclement weather during installation. Prevent infiltration of moisture behind system and deterioration of substrates.

C. Preparation of Wall Surface: The surface shall have no planar irregularities greater than 1/4 inch. The surface to be covered shall be sound, free of hot spots, releasing agents or other residue.

D. General: Comply with system manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as approved by system manufacturer. Mix materials in clean containers. Use materials within time period specified by system manufacturer or discard.

E. Apply primer-sealer over substrates where required by system manufacturer for improving adhesion or for protecting substrates from premature degradation.

F. Application of Insulation Board: Board shall be applied horizontally in running bond. Precut board as required to fit openings, projections, etc. Stagger vertical joints.

G. Apply adhesive to insulation by the notched trowel method in a manner that results in adhesive coating the entire surface of gypsum sheathing once insulation is adhered to the sheathing.

H. Fastening: Follow manufacturer's instructions for application of mechanical fastening to the substrate.

I. Interlock ends at internal and external corners.

J. Abut boards tightly at joints within and between each course to produce flush, continuously even surfaces without gaps or raised edges between insulation boards. If gaps occur, fill with insulation cut to fit gaps exactly; insert without use of adhesive.

K. Allow adhered insulation to remain undisturbed for period prescribed by system manufacturer, but not less than 24 hours, prior to beginning rasping and sanding insulation or application of base coat and reinforcing fabric.

L. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than 1/32 inch from surface of insulation and to remove yellowed areas due to sun exposure; do not create depressions deeper than 1/16 inch.

M. Form joints for sealant application by leaving gaps between adjoining insulation edges as well as between insulation edges and dissimilar adjoining surfaces. Make gaps wide enough to produce joint widths indicated after encapsulation of joint substrates with base coat, reinforcing fabric, and finish coat.

N. Backwrap all exposed edges of insulation board, including those forming substrates of sealed joints within system or between systems and other work, by encapsulating with base coat, reinforcing fabric, and finish coat, unless otherwise indicated.

O. All areas where system joins other material or terminates at roof lines, windows, doors, louvers, heads, sills, etc. must be protected in order that no water can penetrate behind insulation board or protective coating.

P. Reinforcing Fabric: Apply adhesive to entire surface of insulation board to uniform thickness of approximately 1/16 inch. Immediately place the reinforcing fabric against the wet primed coating. Reinforcing fabric shall be continuous at corners and lapped not less than 2-1/2 inches at fabric edges. Avoid wrinkles in embedded fabric. Apply additional thickness or primer/adhesive to completely embed fabric reinforcement.

Q. Additional Reinforcing Fabric: Apply strip reinforcing fabric around openings extending 4 inches beyond perimeter. Apply additional 8 by 16 inch corner reinforcing fabric diagonally at corners of openings (re-entrant corners). Apply 8 inch wide corner reinforcing at both inside and outside corners unless base layer of fabric is lapped at least 4 inches on each side of corners. At decorative grooves (false joints), apply strip reinforcing at least 8 inches wide. Embed strip reinforcing fabric in base coat before applying first layer of reinforcing fabric.

R. Double Base Coat Application: Where indicated, apply a second base coat in same manner as first application, except without reinforcing fabric. Do not apply until first base coat has cured.

S. Apply finish coat over dry base coat in thickness required by system manufacturer to produce a uniform finish of texture and color matching approved sample.

T. Apply finish coat using a trowel directly to reinforced surface. It shall be applied and troweled during the same operation in order to maintain a wet edge. Provide final texture to finish after material has gelled.

U. Install continuous soffit vent component as directed by manufacturer using fasteners compatible with EIFS. Where screed is provided, apply base and finish coat to screed edge in a seamless application to blend with field application.

3.3 CLEANING AND PROTECTION:

A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to

receive system coatings.

B. Provide final protection and maintain conditions in a manner acceptable to Installer and system manufacturer that ensures system's being without damage or deterioration at time of Substantial Completion.

END SECTION 07 24 00

SECTION 07 27 26 - FLUID APPLIED MEMBRANE AIR BARRIER

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Installation of liquid applied Vapor/Air barrier Membrane on standard building exterior grade surfaces indicated on drawings, consisting of preparation of existing and repaired exterior grade surfaces, sealing of cracks, seams and joints.

B. Related sections:

1. Division 3 Section for Concrete
2. Division 4 Section for Masonry
3. Division 7 Section for Insulation; Vapor Barrier
4. Division 7 Section for Joint Sealers
5. Division 8 Section for Doors and Frames
6. Division 8 Section for Window Frames
7. Division 9 Section for Gypsum Board

1.3 REFERENCES:

A. ASTM D 412 Tests for Rubber Properties in Tension.

B. ASTM E Puncture Resistance.

C. ASTM E 96(B) Water Vapor Transmission of Materials.

D. ASTMD 1970 Self-Adhering Polymer Modified Bituminous Sheet Materials.

E. UL 790 Tests for Fire Resistance of Roof Covering Materials.

F. ASTM E 283 Tests for Air Leakage through Exterior Assemblies.

G. ASTM E 331 Tests for Water Penetration of Exterior Assemblies.

H. ASTM E 2178 Test for Air Permeance Rating.

I. ASTM D 1187 Test for Asphalt-Base Emulsions

J. ASTM D 2939 Test for Emulsified Bitumens

1.5 SYSTEM DESCRIPTION:

A. Product provided by this Section is a self-adhesive liquid applied membrane of not less than 40 mils thickness, consisting of a water-based asphalt emulsion modified with a blend of synthetic rubbers and additives which cures to form a flexible, monolithic Vapor/Air Barrier.

1.6 SUBMITTALS:

A. General: Submit in accordance with 01 33 00 - Submittals.

B. Product Data: Submit manufacturer's product literature, installation instructions and standard details.

C. Subcontractor approval by manufacturer: Submit document stating manufacturer's acceptance of subcontractor as an Approved Applicator for the specified materials.

D. Warranty: Submit a sample warranty identifying the terms and conditions.

1.7 QUALITY ASSURANCE:

A. Applicator Qualifications: Applicator shall be experienced in applying the same or similar materials for at least 3 years and shall be specifically approved in writing by the membrane manufacturer.

B. Ordinances, and laws regarding use and application of products that contain volatile organic compounds (VOC).

C. Pre-Application Conference: Prior to beginning work, convene a conference to review conditions, installation procedures, schedules and coordination with other work.

D. Product Components: Vapor/Air components shall be sourced from one manufacturer, including sheet membrane, sealants, primers, adhesives and mastics.

1.8 WARRANTY:

A. Upon completion and acceptance of the work required by this section, the manufacturer will issue a warranty agreeing to promptly replace defective materials for a period of 5 years.

1.9 DELIVERIES, STORAGE AND HANDLING:

A. Deliver materials to project site in original, factory-sealed, unopened containers bearing manufacturer's name and label intact and legible with the following information.

1. Name of material.
2. Manufacturer's stock number and date of manufacture.
3. Materials in protected and well ventilated area.

1.10 PROJECT CONDITIONS:

A. Do not apply membrane if temperature is less than 40 degrees F. or to a damp, frosty or contaminated surface.

B. Coordinate vapor/air barrier application with other trades. The applicator shall have sole right of access to the specified areas for the time needed to complete the installation.

C. Warn personnel against breathing of vapors and contact of material with skin or eyes. Wear applicable protective clothing and respiratory protection gear.

D. Keep flammable products away from spark or flame. Do not allow the use of spark producing equipment during application and until all vapors have dissipated. Post "NO SMOKING" signs.

E. Maintain work area in a neat and orderly condition, removing empty containers, rags, and rubbish daily from the site.

PART 2 - PRODUCTS:

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

B. Low-Emitting Materials: Air barriers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 283, ASTM E 783 or ASTM E 2357.

2.3 VAPOR-RETARDING MEMBRANE AIR BARRIER

A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Elastomeric, modified bituminous or synthetic polymer membrane.

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. Elastomeric, Modified Bituminous Membrane:

1) Carlisle Coatings & Waterproofing Inc.; Barriseal R or Barriseal S.
2) Epro Services, Inc.; Ecoflex-R or Ecoflex-S.
3) Henry Company; Air-Bloc 06.
4) Hohmann & Barnard, Inc.; Textroflash Liquid.
5) Meadows, W. R., Inc.; Air-Shield LM.
6) Tremco Incorporated, an RPM company; ExoAir 120SP/R.

b. Synthetic Polymer Membrane:

1) Grace, W. R., & Co. - Conn.; Perm-A-Barrier Liquid.
2) Henry Company; Air-Bloc 32.
3) Rubber Polymer Corporation, Inc.; Rub-R-Wall Airtight.

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
b. Vapor Permeance: Maximum 0.1 perm; ASTM E 96/E 96M.
c. Ultimate Elongation: Minimum 500 percent; ASTM D 412, Die C.

2.4 ACCESSORY PRODUCTS:

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

B. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by air-barrier material manufacturer.

C. Counterflashing Strip: Modified bituminous, 40-mil- thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil-thick, cross-laminated polyethylene film with release liner backing.

D. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.

E. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

F. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

G. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

H. Modified Bituminous Transition Strip: Vapor retarding, 40 mils thick, smooth surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.

I. Elastomeric Flashing Sheet: ASTM D 2000, minimum 50- to 65-mil- thick, cured sheet neoprene with manufacturer-recommended contact adhesives and lap sealant with stainless-steel termination bars and fasteners.

J. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

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. Dow Corning Corporation; 123 Silicone Seal.
b. Momentive Performance Materials Inc.; US11000 UltraSpan.
c. Pecora Corporation; Sil-Span.
d. Tremco Incorporated, an RPM company; Spectrem Simple Seal.

K. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION:

3.1 INSPECTION:

A. Before any barrier application is started the applicator shall thoroughly examine all surfaces for any deficiencies. Should any deficiencies exist, the architect, owner, or general contractor shall be notified in writing and corrections made.

B. B. Condition of Concrete and Concrete Block Surfaces:

1. Surfaces shall be of sound structural grade and shall have a smooth finish, free of holes, cracks, or other defects.
2. All mortar joints should be struck flush.
3. Adjoining beams, and other substrates should be butted flush with concrete blocks. Irregularities shall be ground or filled as required to achieve flush surfaces.
4. All adjacent metal flashing shall be galvanized or non-ferrous metal, tight screwed or nailed.
5. Surfaces at joints shall be on the same plane.

3.2 SURFACE PREPARATION:

A. The wall surface must be thoroughly clean, dry and free from any surface contaminates or cleaning residue that may harmfully affect the adhesion of the membrane.

B. All cracks over 1/16" in width should be filled with material compatible to the substrate. Most masonry and wood applications can be filled with exterior grade urethane caulking.

C. All crack filler compound to thoroughly cure prior to proceeding.

D. Trim or detail all door, window, and penetrations using manufacturer's standard details.

E. Brick ledge flashing should be in-place prior to application of Vapor/Air Barrier.

3.3 APPLICATION:

A. Clean surfaces to remove residual dust before priming.

B. Detail- Joints, seams, penetrations with either a 30 mil coat of reinforcing fabric, or apply a strip of flashing on primed surface.

C. Apply vapor/air barrier from base of wall working up to allow water to drain over the applied area. Install at required thickness.

D. Terminations: Apply the vapor/air barrier on to the edge of brick ledge flashing, door and window flashing tapes. Extend the vapor/air barrier up above the interior living space or on to the roof vapor/air barrier.

E. Protection: Vapor/Air Sheet Membranes are not designed for permanent exposure and

should be covered as soon as construction scheduling allows.

END SECTION 07 27 26

SECTION 07 41 00 - ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. The extent of each type of preformed roofing and siding is indicated on the drawings and by provisions of this section. Preformed roofing/siding is hereby defined to include panels which are structurally capable of spanning between supports spaced as indicated.

B. The types of panels required include the following:

1. Formed panels, for seaming during installation.

1.3 QUALITY ASSURANCE:

A. Provide metal standing seam system custom fabricated in accordance with SMACCNA details.

1. Nominal standing seam centers: 20 inches.
2. Nominal standing seam height: 1-1/2 inches.

B. Field Measurements: Where possible, prior to fabrication of prefabricated panels, take field measurements of structure of substrates to receive panel system. Allow for trimming panel units where final dimensions cannot be established prior to fabrication.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's product specifications, standard details, certified product test results, installation instructions and general recommendations, as applicable to materials and finishes for each component and for total system of preformed panels.

B. Samples: Submit 2 samples 12 inches square, of each exposed finish material.

C. Shop Drawings: Submit small-scale layouts of panels on walls and roofs, and large-scale details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashing, closures, and special details. Distinguish between factory and field assembly work.

PART 2 - PRODUCTS

2.1 SHEET MATERIALS:

A. Steel for Painting/Coating: Hot-dip zinc coated steel sheet, ASTM A 446, Grade A except where higher strength required for performance, G90 zinc coating, surface treated for maximum coating performance.

A. Steel for Painting/Coating: Hot-dip zinc coated steel sheet, ASTM A 446, Grade A except where higher strength required for performance, G90 zinc coating, surface treated for maximum coating performance.

2.2 METAL FINISHES:

A. General: Apply coatings either before or after forming and fabricating panels, as required by coating process and as required for maximum coating performance capability. Protect coating promptly after application and cure, by application of strippable film or removable adhesive cover, and retain until installation has been completed. Provide colors or color matches as indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

B. Fluorocarbon Coating:

1. Full-strength 70 percent "Kynar 500" coating baked-on for 15 minutes at 450 degrees F, in a dry film thickness of 1.0 mils, 30 percent reflective gloss (ASTM D 523), over 0.3 mil baked-on epoxy primer.
2. Durability: Provide coating which has been field tested under normal range of weathering conditions for minimum of 20 years without significant peel, blister, flake, chip, crack or check in finish, and without chalking in excess of 8 (ASTM D 659), and without fading in excess of 5 NBS units.

2.3 MISCELLANEOUS MATERIALS:

A. Self-Adhering Sheet Underlayment, High Temperature: Minimum of 30- to 40-mil- thick, slip-resisting, polyethylene-film-reinforced top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release paper backing; cold applied.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
2. 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. Carlisle Coatings & Waterproofing, Inc.
b. Grace, W. R. & Co. - Conn.
c. Henry Company.

B. Accessories: Except as indicated as work of another specification section, provide components required for a complete roofing/siding system, including trim, fascias, corner units, hip closures, clips, seam covers, flashing, gutters, sealants, gaskets, filler, closure strips and similar items. Match materials/finishes of preformed panels.

C. Bituminous Coating: Cold-applied asphalt mastic, SSPC Paint 12, compounded for 15-mil dry film thickness per coat.

2.4 PANEL FABRICATION; PERFORMANCES:

A. General: Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, and as required to fulfill performance requirements, which have been demonstrated by factory testing. Comply with indicated profiles and dimensional requirements, and with structural requirements.

B. Metal Gages: Thicknesses required for structural performances, but not less than manufacturer's recommended minimums for profiles and applications indicated, and not less than 22 gage (0.0299 inches) for exterior panels.

C. Required Performances: Fabricate panels and other components of roof/fascia system for the following installed-as-indicated performances:

1. Fascia Loading: 20 pounds per square foot inward; 15 pounds per square foot outward.
2. Roof Loading: 40 pounds per square foot inward; 15 pounds per square foot outward.
3. Water Penetration: No significant, uncontrolled leakage at 4 pounds per square foot pressure with spray test.
4. Air Infiltration: 0.02 cfm per square foot for gross roof/wall areas, with 4 pounds per square foot differential pressure.

D. Apply bituminous coating or other permanent separation materials on concealed panel surfaces where panels would otherwise be in direct contact with substrate materials which are noncompatible or could result in corrosion or deterioration of either material or finishes.

E. Condensation: Fabricate panels for control of condensation, including proper inclusion of seals and provisions for breathing, venting, weeping and draining.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General:

1. Comply with panel fabricator's and material manufacturer's instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the work securely in place, with provisions for thermal/structural movement.
2. Install panels with concealed fasteners.

B. Installation tolerances: Shim and align panel units within installed tolerance of 1/4 inch in 20 foot-0 inch on level/plumb/slope and location/line as indicated, and within 1/8 inch offset of adjoining faces and of alignment of matching profiles.

C. Seaming: Complete seaming of panel joints by operation of portable power-driven equipment of type recommended by panel manufacturer.

D. Joint Sealers:

1. Install gaskets, joint fillers and sealants where indicated and where required for weatherproof performance of panel systems. Provide types of gaskets and sealants/fillers indicated or, if not otherwise indicated, types recommended by panel manufacturer.
2. Refer to other sections of these specifications for product and installation requirements applicable to indicated joint sealers.

E. Joint Sealers: Refer to other sections of these specifications for post-installation requirements on joints sealers; not work of this section.

3.2 CLEANING AND PROTECTION:

A. Damaged Units: Replace panels and other components of the work which have been damaged or have deteriorated beyond successful repair by means of finish touch-up or similar minor repair procedures.

B. Cleaning: Remove protective coverings and strippable films (if any) at time in project construction sequence which will afford greatest protection of work. Clean finished surfaces as recommended by panel manufacturer, and maintain in a clean condition during construction.

C. Protection: Installer shall advise Contractor of protection and surveillance procedures, as required to ensure that work of this section will be without damage or deterioration at time of substantial completion.

END SECTION 07 41 00

SECTION 07 42 00 - SOFFIT PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. The extent of each type of preformed roofing and siding is indicated on the drawings and by provisions of this section. Preformed roofing/siding is hereby defined to include panels which are structurally capable of spanning between supports spaced as indicated.

B. The types of panels required include the following:

1. Metal Soffit panels.

1.3 QUALITY ASSURANCE:

A. Field Measurements: Where possible, prior to fabrication of prefabricated panels, take field measurements of structure of substrates to receive panel system. Allow for trimming panel units where final dimensions cannot be established prior to fabrication.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's product specifications, standard details, certified product test results, installation instructions and general recommendations, as applicable to materials and finishes for each component and for total system of preformed panels.

B. Samples: Submit 2 samples 12 inches square, of each exposed finish material.

C. Shop Drawings: Submit small-scale layouts of panels on walls and roofs, and large-scale details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashing, closures, and special details. Distinguish between factory and field assembly work.

1.5 FINISH WARRANTY:

A. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET MATERIALS:

A. Steel for Painting/Coating: Hot-dip zinc coated steel sheet, ASTM A 446, Grade A except where higher strength required for performance, G90 zinc coating, surface treated for maximum coating performance.

2.2 METAL SOFFIT PANELS

A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Flush-Profile Metal Soffit Panels Solid panels formed with vertical panel edges and flat pan between panel edges; with flush joint between panels.

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. AEP-Span.
b. Architectural Building Components.
c. CENTRIA Architectural Systems.
d. Firestone Una-Clad.
e. Petersen Aluminum Corporation.

2. Material: Zinc-coated (galvanized) steel sheet, 0.022-inch nominal thickness.

a. Exterior Finish: 2-coat fluoropolymer.
b. Color: As selected by Architect from manufacturer's full range.

3. Panel Coverage: 12 inches.
4. Panel Height: 1 inch.

2.3 METAL FINISHES:

A. General: Apply coatings either before or after forming and fabricating panels, as required by coating process and as required for maximum coating performance capability. Protect coating promptly after application and cure, by application of strippable film or removable adhesive cover, and retain until installation has been completed. Provide colors or color matches as indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

B. Fluorocarbon Coating:

1. Full-strength 70 percent "Kynar 500/Hylar 5000" coating baked-on for 15 minutes at 450 degrees F, in a dry film thickness of 1.0 mils, 30 percent reflective gloss (ASTM D 523), over 0.3 mil baked-on epoxy primer.
2. Durability: Provide coating which has been field tested under normal range of weathering conditions for minimum of 20 years without significant peel, blister,

flake, chip, crack or check in finish, and without chalking in excess of 8 (ASTM D 659), and without fading in excess of 5 NBS units.

2.4 SECONDARY STRUCTURAL FRAMING:

A. Secondary Framing: Manufacturer's standard secondary framing members, including prulins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural steel sheet or roll-formed, metallic-coated steel sheet prepainted with coil coating, unless otherwise indicated, to comply with the following:

2. Girts: C- or Z-shaped sections; fabricated from minimum 0.0598 inch thick steel sheet, minimum 2 ½ inch wide flanges, depth 8 inches. Form ends of Z-sections with stiffening lips angled 40 degrees to flange.
4. Base or Sill Angles: Minimum 3x2x0.0598 inch zinc-coated steel sheet.

B. Factory-Primed Finish: Apply specified primer immediately after cleaning and pretreating.

1. Prime secondary structural framing members to a minimum dry film thickness of 1 mil. on each side.

2.5 MISCELLANEOUS MATERIALS:

A. Fasteners: Manufacturer's standard noncorrosive types, with exterior heads gasketed.

B. Accessories: Except as indicated as work of another specification section, provide components required for a complete soffit system.

2.6 PANEL FABRICATION; PERFORMANCES:

A. General: Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, and as required to fulfill performance requirements, which have been demonstrated by factory testing. Comply with indicated profiles and dimensional requirements, and with structural requirements.

B. Metal Gages: Thicknesses required for structural performances, but not less than manufacturer's recommended minimums for profiles and applications indicated, and not less than 22 gage (0.0299 inches) for exterior panels and 28 gage (0.0149 inches) for interior liner panels.

C. Required Performances: Fabricate panels and other components of soffit system for the following installed-as-indicated performances:

1. Wall Loading: 20 pounds per square foot inward; 15 pounds per square foot outward.
2. Water Penetration: No significant, uncontrolled leakage at 4 pounds per square foot pressure with spray test.

D. Apply bituminous coating or other permanent separation materials on concealed panel surfaces where panels would otherwise be in direct contact with substrate materials which are noncompatible or could result in corrosion or deterioration of either material or finishes.

E. Fabricate panel joints with captive gaskets or separator strips, which provide a tight seal and prevent metal-to-metal contact in a manner which will minimize noise from movements within panel system.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General:

1. Comply with soffit panel fabricator's and material manufacturer's instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the work securely in place, with provisions for thermal/structural movement.
2. Install panels with concealed fasteners.

B. Installation tolerances: Shim and align panel units within installed tolerance of 1/4 inch in 20 foot-0 inch on level/plumb/slope and location/line as indicated, and within 1/8 inch offset of adjoining faces and of alignment of matching profiles.

C. Joint Sealers:

1. Refer to other sections of these specifications for product and installation requirements applicable to indicated joint sealers.

3.2 CLEANING AND PROTECTION:

A. Damaged Units: Replace panels and other components of the work which have been damaged or have deteriorated beyond successful repair by means of finish touch-up or similar minor repair procedures.

B. Cleaning: Remove protective coverings and strippable films (if any) at time in project construction sequence which will afford greatest protection of work. Clean finished surfaces as recommended by panel manufacturer, and maintain in a clean condition during construction.

C. Protection: Installer shall advise Contractor of protection and surveillance procedures, as required to ensure that work of this section will be without damage or deterioration at time of substantial completion.

END SECTION 07 41 00

SECTION 07 53 00 - ELASTOMERIC MEMBRANE ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This Section includes the following:

1. Loosely laid and ballasted sheet roofing.
2. Roof insulation.
3. Aggregate ballast.

B. Related Sections:

1. Division 6 Section for "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Division 7 Section for "Flashing and Sheet Metal" for sheet metal flashings, counterflashings, and copings.
3. Division 7 Section for "Roof Accessories" for roof hatches, prefabricated curbs and supports, expansion joint systems, plastic skylight units.

1.3 PERFORMANCE REQUIREMENTS:

A. General: Install sheet membrane roofing and base flashing that are watertight; will not permit the passage of liquid water, and will withstand wind loads, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. FM Listing: Provide sheet membrane, base flashings, and component materials that meet requirements of FM 4450 and FM 4470 as part of a roofing system and that are listed in FM's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM markings.

1. The roofing system shall comply with the following:

a. Fire/Windstorm Classification: Class 1A-60.

D. Roofing System Design: Provide a roofing system that complies with roofing system manufacturer's written design instructions and with the following:

1. ANSI/RMA/SPRI RP-4, "Wind Design Guide for Ballasted Single-Ply Roofing Systems."

a. Exposure Category: Exposure B.
b. System Design: System 1.

1.4 SUBMITTALS:

A. Product Data: Submit product data for each type of roofing product specified. Include data substantiating that materials comply with requirements.

B. Shop Drawings: Submit plans, sections and details for the following:

1. Base flashings (at wall/parapets, curbs, supports) and membrane terminations (at copings, termination bars, counterflashings.).
2. Pipe flashings.
3. Insulation layouts, including crickets and slopes.

C. Submit manufacturer's instructions for surface preparation, elastic flashing, joint cover sheet and joint and crack sealants with temperature range for application.

D. Samples:

1. Submit samples of roof pavers.
2. Submit 3-lb. samples of aggregate surfacing material (rock ballast)

1.5 QUALITY ASSURANCE:

A. Manufacturer: Obtain primary elastomeric sheet roofing from a single manufacturer, to greatest extend possible. Provide secondary materials only as recommended by manufacturer or primary materials.

B. Installer:

1. A firm with not less than 3 years of successful experience in installation of roofing systems similar to those required for this project and which is acceptable to or licensed by manufacturer of primary roofing materials.
2. As applicable, assign work closely associated with elastomeric sheet roofing, including (but not limited to) vapor barriers, insulation, flashing and counterflashing, expansion joints, and joint sealers, to installer of flexible sheet roofing.

C. Pre-roofing Conference: Prior to installation of roofing and associated work, meet at project site with Installer, roofing manufacturer, installers of related work, and other entities concerned with roofing performance, including (where applicable) Owner's insurer, test agencies, governing authorities, Architect, and Owner. Record discussions and agreements and furnish copy to each participant.

1. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
2. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
3. Review loading limitations of deck during and after roofing.
4. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
5. Review temporary protection requirements for roofing system during and after installations.

D. Insurance Certification: Assist Owner in preparation and submittal of whatever roof installation acceptance certification may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid materials from direct sunlight. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.7 PROJECT CONDITIONS:

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

1.8 WARRANTY:

A. Provide written warranty, signed by contractor, installer and manufacturer of primary roofing materials, agreeing to replace/repair defective materials and workmanship, including significant leakage of water, abnormal aging or deterioration of materials, and other failures of sheet roofing to perform as required within warranty period. Repairs and replacements required because of acts of Nature and other events beyond Contractors/Installers/Manufacturer's control (and which exceed performance requirements) shall be completed by Contractor/Installer and paid for by Owner at prevailing rates.

1. Warranty period is 20 years after date of substantial completion.

PART 2 - PRODUCTS

2.1 EPDM MANUFACTURERS:

A. Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Sure Seal; Carlisle Syntec Systems
Rubbergard; Firestone Building Products
Versigard; Versico, Inc.
Celo-1; Celotex Corporation
SPM; John-Manville

2.2 ELASTOMERIC SHEET MATERIALS:

A. EPDM Sheet: Uniform, flexible sheet formed from a terpolymer of ethylene-propylene-diene, complying with ASTM D 4637, Type 1, of the following grade, class, thickness,

backing, and exposed face color:

1. Grade and class: Grade 1 and Class U, unreinforced.
2. Thickness: 60 mils, nominal.
3. Backing: Unbacked.
4. Exposed Face Color: Black.

B. Sheet Flashing: Manufacturer's standard system, 60 mils thick EPDM, uncured or cured, according to application.

2.3 AUXILIARY MATERIALS:

A. Sheet Seaming System: Manufacturer's standard materials for sealing lapped joints, including edge sealer to cover exposed spliced edges as recommended by manufacturer.

B. Flashing Accessories: Types recommended by manufacturer of membrane material provided at locations indicated and at locations recommended by manufacturer and including adhesive tapes, flashing cements and sealants.

C. Bonding Adhesive: Manufacturer's standard bonding adhesive for adhered membrane systems.

D. Miscellaneous Accessories: Provide pourable sealers, preformed cone pipe flashings, and other accessories recommended by roofing system manufacturer for intended use.

2.4 INSULATING MATERIALS:

A. General: Provide insulating materials to comply with requirements indicated for materials and compliance with referenced standards in sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths and lengths.

B. Polyisocyanurate Board (Fill) Insulation: Rigid, cellular polyisocyanurate thermal insulation with core formed by using HCFCs as blowing agents to comply with ASTM C 1289, with Type II, glass-fiber mat facers both major surfaces. Aged R value of 6 minimum per inch of thickness.

1. Provide insulation in two layers of similar thickness, for double layer installation.
2. Provide preformed saddles, crickets, and other insulation shapes where indicated for sloping to drain.

2.5 INSULATION ACCESSORIES:

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Cold Fluid-Applied Adhesive: Manufacturer's standard cold fluid-applied adhesive formulated to adhere roof insulation to substrate.

D. Metal Securement System: Perimeter securement flashing and strapping fabricated from stainless steel, a minimum of 0.031 inch thick.

2.6 AGGREGATE SURFACE BALLAST:

A. Smooth, washed, rounded riverbed gravel or other acceptable smooth-faced stone. Comply with ASTM D 448, Size 2, 1-1/2 inches to 2-1/2 inches washed rounded riverbed gravel, which will withstand weather exposure without significant deterioration and acceptable to membrane and insulation manufacturers.

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 set and braced and that roof drains 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 Division 05 Section "Steel Decking."
4. 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.

D. Install acoustical roof deck rib insulation strips, specified in Division 05 Section "Steel Decking," according to acoustical roof deck manufacturer's written instructions.

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 manufacturer's written instructions for installing roof insulation.

C. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches or greater, install 2 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 and Adhered Insulation: Install each layer of insulation and secure first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten first layer of insulation according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
2. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
3. Install subsequent layers of insulation in a cold fluid-applied adhesive.

3.4 LOOSELY LAID AND BALLASTED ROOFING MEMBRANE INSTALLATION

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

B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing membranes, without stretching, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Mechanically fasten or adhere perimeter of roofing membrane according to requirements in ANSI/SPRI RP-4.

E. Apply roofing membrane with side laps shingled with slope of deck where possible.

F. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.

1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.

G. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.

H. Leave seams uncovered until inspected by membrane roofing system manufacturer.

I. Repair tears, voids, and lapped seams in roofing that does not meet requirements.

J. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

K. Install roofing membrane and auxiliary materials to tie in to existing roofing.

L. Adhere epichlorohydrin sheet over roofing membrane at locations indicated.

M. Aggregate Ballast: Apply aggregate ballast uniformly over roofing membrane at the rate required by membrane roofing system manufacturer, but not less than the following, spreading with care to minimize possibility of damage to membrane roofing system. Lay ballast as roofing membrane is installed, leaving roofing membrane ballasted at the end of the workday.

1. Ballast Weight: Size 4 aggregate, 10 lb/sq. ft.

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 bonding adhesive 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 where recommended.

3.6 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.

1. Notify Architect or Owner 48 hours in advance of date and time of inspection.

B. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply 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 SECTION 07 53 00

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Metal counter flashing; and base flashing (if any).
2. Gutters and downspouts (rain drainage).
3. Exposed metal trim/fascia units.

B. Related sections:

1. Through wall flashing for masonry is specified in Division 4 Section "Unit Masonry".
2. Roof panels are specified in another Division 7 section.
3. Soffit panels are specified in another Division 7 section.

1.3 SUBMITTALS:

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

B. Samples; Flashing, Sheet Metal, Accessories:

1. Submit 2, 8 inch square samples of specified sheet materials to be exposed as finished surfaces.

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

1.4 JOB CONDITIONS:

A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of the work and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 FLASHING AND SHEET METAL MATERIALS:

A. Sheet Metal Flashing/Trim:

1. Paint coated sheet steel: Shop formed, 0.028 inches (24 gage) thick prior to painting, hot-dipped galvanized steel, commercial quality AISI G90 extra smooth. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions. Surface: Smooth, flat. Color: As selected by Architect from manufacturer's full range.

2. Miscellaneous Materials and Accessories:

   a. Solder: For use with steel, provide 50 - 50 tin/lead solder (ASTM B 32), with rosin flux.
   b. Solder: For use with stainless steel, provide 60 - 40 tin/lead solder (ASTM B 32), with acid-chloride type flux, except use rosin flux over tinned surfaces.
   c. Fasteners: Same metal as flashing/sheet metal or, other noncorrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.
   d. Bituminous Coating: FS TT-C-494 or SSPC - Paint 12, solvent type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.
   e. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
   f. Elastomeric Sealant: Generic type recommended by manufacturer of metal and fabricator of components being sealed; comply with FS TT-S-0027, TT-S-00230, or TT-S-001543.
   g. Epoxy Seam Sealer: 2-part noncorrosive metal seam cementing compound, recommended by manufacturer for exterior/interior nonmoving joints including riveted joints.
   h. Adhesives: Type recommended by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.
   i. Paper Slip Sheet: 5-lb rosin-sized building paper.
   j. Polyethylene Underlayment: 6-mil carbonated polyethylene film; FS L-P-512.
   k. Reglets: Metal of the type and profile indicated, compatible with flashing indicated, noncorrosive.
   l. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.
   m. Roofing Cement: ASTM D 4586, Type I, asbestos free, asphaltic based.

2.2 FABRICATED UNITS:

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

B. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. For metal

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

C. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

D. Sealant Joints: Where movable, nonexpansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with industry standards.

E. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

F. Shop Finish, Rain Drainage: Provide manufacturer's standard baked-on white acrylic shop finish on sheet metal rain drainage units (gutters, downspouts, and similar exposed units); 1.0 mil dry film thickness.

G. Gravel stops and joint covers: Prefinished sheet steel.

H. Gutters and downspouts:

1. Shop fabricate metal gutters, downspouts, conductor heads, metal flashing and similar items to comply with profiles and sizes indicated and to comply with standard industry details shown in the SMACNA "Architectural Sheet Metal Manual." Unless otherwise indicated, provide soldered flat-lock seams and fold back metal to form a hem on concealed side of exposed edges. Fabricate work from Prefinished sheet steel.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS:

A. General: Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations, and with SMACNA "Architectural Sheet Metal Manual." Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints and seams which will be permanently watertight and weatherproof.

B. Underlayment: Where stainless steel or aluminum is to be installed directly on cementitious or wood substrates, install a course of paper slip sheet and a course of polyethylene underlayment.

C. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.

D. Install reglets to receive counter flashing in manner and by methods indicated. Where shown in masonry, furnish reglets to trades of masonry work, for installation as work of Division 4 sections.

E. Install counterflashing in reglets, either by snap-in seal arrangement, or by wedging in place for anchorage and filling reglet with mastic or elastomeric sealant, as indicated and depending on degree of sealant exposure.

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

3.2 CLEANING AND PROTECTION:

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

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

END SECTION 07 62 00

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:

1. Floors.
2. Roofs.
3. Walls and partitions.

B. Related Sections include the following:

1. Division 3 Section "Concrete" for construction of openings in concrete slabs and floors.
2. Divisions 21, 22 and 23 Sections specifying duct and piping penetrations.
3. Divisions 26, 27 and 28 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.

1. Fire-resistance-rated load-bearing walls, including partitions, with fire-protection-rated openings.
2. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
3. Fire-resistance-rated floor assemblies.

B. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

1. Penetrations located outside wall cavities.
2. Penetrations located in construction containing fire-protection-rated openings.
3. Penetrating items larger than 4-inch-diameter nominal pipe or 16 square inches n overall cross-sectional area.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

1.4 SUBMITTALS

A. Product Data: For each type of through-penetration firestop system product indicated.

B. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Product Certificates: Issued by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.

E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed through-penetration firestop systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:.

   a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
   b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:

      1) UL in "Fire Resistance Directory."

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. A/D Fire Protection Systems Inc.
2. DAP Inc.
3. Firestop Systems Inc.
4. Hilti Construction Chemicals, Inc.
5. Instant Firestop Mfg. Inc.
6. International Protective Coatings Corp.
7. Isolatek International.
8. Nelson Firestop Products.
9. NUCO Industries.
10. RectorSeal Corporation (The).
11. Specified Technologies Inc.
12. 3M Fire Protection Products.
13. Tremco.
14. United States Gypsum Company.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:
    a. Slag/Rock-wool-fiber insulation.
    b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    c. Fire-rated form board.
    d. Fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials appropriate to substrate and designated fire rating by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

H. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

I. Pillows/Bags: Reusable, heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.

J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

K. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Proceed with enclosing through-penetration firestop systems with other construction only after inspection by pertinent authorities has been completed.

B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 IDENTIFICATION

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

END OF SECTION 07 84 13

SECTION 07 92 00 - JOINT SEALERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. The applications for joint sealers as work of this section include the following:

1. Control and expansion joints in cast-in-place concrete.
2. Control and expansion joints in unit masonry.
3. Joints in exterior insulation and finish systems.
4. Joints between metal panels.
5. Perimeter joints between interior and exterior walls and frames of windows and doors.
6. Flashing and coping joints.
7. Interior wall/ceiling joints.
8. Joints at hollow metal frames and floors.
9. Tile control and expansion joints.
10. Joints between plumbing fixtures and adjoining walls and floors.
11. Bed joint under thresholds.
12. Perimeter joints of interior and exterior wall penetrations.
13. Joints between glass mat gypsum sheathing, and over fasteners.
14. Joints between differing materials.
15. Other joints as indicated.

B. Related Sections:

1. Division 4 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Division 7 Section "Penetration Firestopping.
3. Division 8 Section "Glass and Glazing" for glazing sealants.
4. Division 9 Section "Gypsum Board" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
5. Division 31 Section "Concrete Paving Joint Sealants" for traffic grade sealants in concrete.

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's product specifications, handling / installation / curing instructions, and performance tested data sheets for each elastomeric product required. Submit color chart showing full line of color choices.

1.4 JOB CONDITIONS:

A. Weather Conditions: Do not proceed with installation of liquid sealants under unfavorable weather conditions. Install elastomeric sealants when temperature is in lower third of temperature range recommended by manufacturer for installation.

1.5 GUARANTEE:

A. Submit 2 copies of written 2 year guarantee agreeing to repair or replace joint sealers which fail to perform as airtight and watertight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, stain resistance, or general durability; or appear to deteriorate in any other manner. Provide guarantee signed by the installer and contractor. Provide with copies with product submittals for review by Architect and for final inclusion in O&M Manuals.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. General Sealer Performance Requirements: Provide colors indicated or, if not otherwise indicated, as selected by Architect from manufacturer's extended line of colors. Select materials for compatibility with joint surfaces and other indicated exposures, and except as otherwise indicated select modulus of elasticity and hardness or grade recommended by manufacturer for each application indicated. Where exposed to foot traffic, select marketing materials of sufficient strength and hardness to withstand stiletto heel traffic without damage or deterioration of sealer system.

B. Colors: To be selected by Architect from manufacturer's standard colors.

C. Elastomeric Sealants:

1. Two-Component Nonsag Urethane Sealant: (General Exterior)

a. Urethane-based, two-part elastomeric sealant, complying with ASTM C 920, Class 25 and Class 50, Type M (multicomponent), Grade NS (nonsag). Uses related to exposure: NT (nontraffic) and T (traffic).

b. Available products:

1) Pecora Corporation; Dynatrol II.
2) Schnee-Morehead, Inc.; Permathane SM 7200.
3) Sika Corporation, Inc.; Sikaflex - 2c NS TG.
4) Sonneborn, Division of ChemRex Inc.; NP 2.
5) Tremco; Dymeric 511.
6) Tremco; Vulkem 227.
7) Tremco; Vulkem 922.
8) Tremco; Vulkem 322 DS.

2. One-Component Urethane Sealant: (General Interior)

a. Urethane-based one-part elastomeric sealant, complying with ASTM C 920, Class 25 and Class 50, Type S (single component), Grade NS (nonsag). Uses related to exposure: NT (nontraffic). For joints less than 1/2 inch in width.

b. Available products:

1) Bostik Findley; Chem-Calk 900.
2) Bostik Findley; Chem-Calk 915.
3) Bostik Findley; Chem-Calk 916 Textured.

4) Bostik Findley; Chem-Calk 2639.
5) Pecora Corporation; Dynatrol I-XL.
6) Polymeric Systems Inc.; Flexiprene 1000.
7) Polymeric Systems Inc.; PSI-901.
8) Schnee-Morehead, Inc.; Permathane SM7100.
9) Schnee-Morehead, Inc.; Permathane SM7108.
10) Schnee-Morehead, Inc.; Permathane SM7110.
11) Sika Corporation, Inc.; Sikaflex - 15LM.
12) Tremco; DyMonic.
13) Tremco; Vulkem 921.
14) Tremco; Vulkem 931.

3. Exterior Silicone Rubber, Neutral Curing and Basic curing Sealant: complying with ASTM C 920, Class 50, Type S (single component), Grade NS (nonsag). Uses related to exposure: NT (nontraffic). For use at EIFS and glass mat gypsum sheathing, metal panel systems.

a. Silicone rubber-based, one-part elastomeric sealant recommended by manufacturer for exterior joints.

b. Available products:

1) Dow Corning Corporation; 790.
2) GE Silicones; SilPruf LM SCS2700.
3) Tremco; Spectrem 1 (Basic).
4) GE Silicones; SilPruf SCS2000.
5) Pecora Corporation; 864.
6) Pecora Corporation; 890.
7) Polymeric Systems Inc.; PSI-641.
8) Sonneborn, Division of ChemRex Inc.; Omniseal.
9) Tremco; Spectrem 3.
10) Dow Corning Corporation; 791.
11) GE Silicones; UltraPruf II SCS2900.
12) Pecora Corporation; 865.
13) Pecora Corporation; 895.
14) Pecora Corporation; 898.

c. Provide nonacid, porous bond type silicone rubber sealant where one or both joint faces are masonry, stone, concrete or other porous materials.

4. Mildew-Resistant Silicone Rubber Sealant:

a. Silicone rubber-based, neutral curing, one-part elastomeric sealant, complying with ASTM C 920, Class 25, Type S (single component), Grade NS (nonsag). Uses related to exposure: NT (nontraffic). Compounded specifically for mildew resistance and recommended by manufacturer for interior joints in wet areas and around plumbing fixtures; passing ANSI A136.1 test for mold growth.

b. Approved products are:

1) Pecora Corporation; 898 Silicone sanitary Sealant
2) Tremco; Tremsil 600 White.

C. Nonelastomeric Sealants and Caulking Compounds: (General Interior - non-movement joints; interior door frames, etc.)

1. One-Component Acrylic Sealant:

a. Acrylic terpolymer, solvent based, one part, thermo plastic sealant compound; solids not less than 95 percent acrylic; complying with ASTM C 1311 or FS TT-S-00230; recommended by manufacturer for general use as exposed building construction sealant.

b. Available products:

1) Bostik Findley; Chem-Calk 600.
2) Pecora Corporation; AC-20+.
3) Schnee-Morehead, Inc.; SM 8200.
4) Sonneborn, Division of ChemRex Inc.; Sonolac.
5) Tremco; Tremflex 834.

D. Preformed Compressible Foam Sealants: Manufacturer's standard open-cell, flexible foam strip of polyurethane or other weather resistant foam, saturated with butylene or other nondrying liquid sealant/adhesive, to a formulation which will form a paintable watertight joint at 50 percent compression, without staining, migrating, hardening or other performance failure.

E. Cellular/Foam Joint Fillers:

1. Closed-Cell Synthetic Rubber Joint Filler: Provide expanded synthetic rubber complying with ASTM D 1056, Class SC-E (oil-resistant and medium swell), of 2 to 5 psi compression deflection (Grade SCE 41); except provide 13 to 17 psi compression deflection (Grade SCE 44) where filler is applied under sealant exposed to traffic.

F. Miscellaneous Materials:

1. Joint Primer/Sealer: Provide type of joint primer/sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed.
2. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape where applicable.
3. Sealant Backer Rod: Compressible rod stock of polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable nonabsorptive material as recommended by sealant manufacturer for compatibility with sealant.

a. Sealant backer rods for joints in Exterior Insulation and Finish Systems shall be closed cell materials.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS:

A. Comply with manufacturer's printed instructions except where more stringent requirements are shown or specified, and except where manufacturer's technical representative directs otherwise.

3.2 JOINT PREPARATION:

A. Clean joint surfaces immediately before installation of sealant or caulking compound. Remove dirt, insecure coatings, moisture and other substances which could interfere with bond of sealant or caulking compound. Etch concrete and masonry joint surfaces as recommended by sealant manufacturer. Roughen vitreous and glazed joint surfaces as recommended by sealant manufacturer.

B. Prime or seal joint surfaces where indicated, and where recommended by sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.

3.3 INSTALLATION:

A. Set joint filler units at proper depth or position in joint to coordinate with other work, including installation of bond breakers, backer rods and sealants. Do not leave voids or gaps between ends of joint filler units.

B. Install sealant backer rod for liquid elastomeric sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for application indicated.

C. Install bond breaker tape where indicated and where required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

D. Employ only proven installation techniques, which will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

E. Install sealant to depths as shown or, if not shown, as recommended by sealant manufacturer but within the following general limitations, measured at center (thin) section of bead:

1. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
2. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to a depth in range of 75 percent to 125 percent of joint width.

F. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.

G. Recess exposed edges of gaskets and exposed joint fillers slightly behind adjoining surfaces, unless otherwise shown, so that compressed units will not protrude from joints.

H. Bond ends of gaskets together with adhesive or "weld" by other means as recommended by manufacturer to ensure continuous watertight and airtight performance. Miter-cut and bond ends at corners unless molded corner units are provided.

3.4 CURE AND PROTECTION:

A. Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability. Advise Contractor of procedures required for cure and protection of

joint sealers during construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at time of substantial completion.

END SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following products manufactured in accordance with SDI recommended standards.

1. Doors: Flush hollow or composite construction for interior and exterior locations.
2. Frames: Pressed steel frames for doors.

B. Related Sections:

1. Division 4 Section "Unit Masonry" for building anchors into and grouting frames in masonry construction.
2. Division 8 Section "Wood doors."
3. Division 8 Section "Hardware" for door hardware.
4. Division 8 Section "Glass and Glazing" for glass in steel doors and frames.
5. Division 9 Section "Painting" for field painting primed doors and frames.

1.3 QUALITY ASSURANCE:

A. Doors: Complying with ANSI 250.8 for level and model and ANSI A250.4 for physical endurance level indicated, 1-3/4 inches thick.

1. Interior Doors: Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
2. Exterior Doors: Full-insulated, Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless), metallic-coated steel sheet faces.
3. Thermal-Resistance Value: R not less than 6.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
4. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as door face sheets.

B. Frames: ANSI A250.8; Concealed fastenings unless otherwise indicated.

1. Steel Sheet Thickness: 16-gauge.
2. Fabricate interior frames with mitered or coped and face welded corners.
3. Fabricate exterior frames from metallic-coated steel sheet, with mitered or coped and continuously welded corners.
4. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.
5. Frame Anchors: Not less than 0.042 inch thick.

1.4 SUBMITTALS:

A. Product Data: Submit product data for door and frame components.

B. Submit shop drawings showing following items.

1. Frames: Corner construction, reinforcing, anchors, finish, materials, hardware locations and profiles.
2. Doors: Edge construction, cut-out locations, design, reinforcing, materials, finishes and hardware locations.
3. Shop drawings shall show door and frame schedule using same door/frame reference numbers as those indicated on the drawings and door schedule.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage.

B. Inspect doors and frames on delivery for damage. Minor damages may be repaired provided refinished items match new work and are acceptable to the Architect; otherwise, remove and replace damaged items as directed.

C. Store doors and frames at building site under cover. Place units on minimum 4-inch high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If cardboard wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4 inch spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Interior Doors/Frames: Commercial quality, cold rolled, stretcher leveled, matte finish steel conforming to ASTM A 366.

B. Exterior Doors/Frames: Commercial quality, cold rolled, stretcher leveled, steel conforming to ASTM A 366/A 366M; zinc coated (galvanized) to comply with ASTM A 653/A 653M G60 galvanized coating.

2.2 GENERAL:

A. Fabricate in largest size units permitted by shipping restrictions.

B. Grind exposed welds smooth.

C. Locate hardware items in accordance with NAAMM Standard CHM-2.

D. Mortise, reinforce, drill and tap for templated mortise hardware in accordance with templates furnished by hardware supplier.

E. Reinforce for all surface mounted hardware.

F. Reinforce for handed doors as follows: Hinges or Pivots - 7 gage; all other hardware - 12 gage.

G. Identify all items as to location in project.

H. Install hardware items requiring factory installation.

I. Reinforce head of frames over 42 inches wide with 12 gage closer reinforcing sleeve full width of frame.

2.3 DOORS:

A. Interior Doors: ANSI/SDI-100, Grade II, heavy-duty, Model 2, minimum 18-gage cold rolled sheet steel faces.

B. Exterior Doors: ANSI/SDI-100, Grade III, extra heavy-duty, Model 2, minimum 16-gage galvanized steel faces. Exterior doors and frames are to be fabricated as thermal insulating assemblies and tested in accordance with ASTM C 236 OR ASTM C 976 on fully operable door assemblies. Insulated core to be polyurethane.

C. Fabricate Clearance as Follows: 1/8 inch at jamb and head; 1/2 inch between bottom of door and finished floor; 1/8 inch between bottom of door and top of threshold.

D. Bevel lock or latch edge of door 1/8 inch in 2 inches.

E. Close top of exterior doors with filler channel.

F. V-bevel meeting edge at pairs of doors.

G. Fabricate glazed openings with minimum 20 gage flush type edge moldings butted at corners and shipped to the job site screwed to the frames with countersunk oval head self-tapping screws maximum 16 inches on center.

2.4 FRAMES:

A. Interior Frames: Fabricate of 16-gage cold rolled steel with 14-gage floor anchors welded inside each jamb.

B. Exterior Frames: Fabricate of 14-gage cold rolled galvanized steel with 14-gage floor anchors welded inside each jamb.

C. Fabricate with jamb anchors appropriate to wall construction.

D. Provide 16 gage temporary spreader channel or angle at bottom of frame.

E. Drill door stops at single interior doors for 3 mutes on strike jamb opposite hinge locations.

F. Drill head jamb stop at interior door for mutes located 3 inches from center edge of door at pairs or double egress.

G. Weld 18 gage jamb anchors to inside of frame each side of opening at metal stud walls with 4 anchors for frames to 7 foot-6 inch and one additional for each 2 foot or fraction thereof over 7 foot-6 inch.

H. Weld 26 gage closed metal cover over hardware mortises of frames in masonry walls.

I. Machine-miter and full weld frame corner joints for invisible face seam.

K. Saw-miter and full weld frame corner joints for invisible face seam.

2.5 FINISHES:

A. Clean metal to insure primer adhesion.

B. Prime paint metal with rust inhibitive paint compatible with finish coat of paint. Refer to Section 09 91 00 for type of paint for finish coat to be applied.

C. Touch up areas where zinc coating is burned off by welding with zinc rich paint prior to applying prime paint.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Set frames in proper location and level the header. Shim under jamb if necessary. Secure each jamb to floor at jamb anchors with two anchors.

B. Brace frame to floor or shore to structure above. Plumb and square frame.

C. Fill all screw and anchor heads with auto body compound and finish smooth.

D. Touch up all screw heads, welds and abrasions with primer same as applied at the factory prior to finish painting.

E. Set frames with field splices to a hairline joint.

F. Weld all joints to adjacent members on multiple openings.

G. Remove protective plastic wrappings from prefinished items.

END SECTION 08 11 13

SECTION 08 14 00 - WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Solid core flush wood doors with veneer faces.

B. Shop finishing of wood doors is included in this section.

C. Factory fitting to frames (prefitting) and factory preparation for hardware (premachining) for wood doors is included in this section.

1.3 QUALITY ASSURANCE:

A. ANSI/WDMA Quality Standard: I.S.1-A – 2004, "Architectural Wood Flush Doors," of the Wood Door Manufacturer's Association.

B. Fire-Rated Wood Doors: Provide wood doors that comply with NFPA 80; are identical in materials and construction to units tested in door and frame assemblies per ASTM E 152; and are labeled and listed by UL, Intertek Testing Services, or other testing and inspection agency acceptable to authorities having jurisdiction.

C. Manufacturer: Obtain doors from a single manufacturer to insure uniformity in quality of appearance and construction, unless otherwise indicated.

1.4 SUBMITTALS:

A. Product Data:

1. Submit door manufacturer's product data, specifications and installation instructions for each type of wood door.
2. Include details of core and edge construction, trim for openings and louvers (if any) and similar components.
3. Include finishing specifications for doors to receive factory applied shop finish.
4. Include certifications as may be required to show compliance with specifications.

B. Shop Drawings: Submit shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for factory finishing and other pertinent data.

C. Samples: Submit samples for the following:

1. Shop Finished Doors: Submit 3 samples, 1 foot-0 inches square, showing fully completed shop finish on same veneer and edge construction which will be used on shop finished doors.

D. Specific Product Warranty:

1. Submit written agreement in door manufacturer's standard form signed by Manufacturer, Installer and Contractor, agreeing to repair or replace defective doors which have warped (bow, cup or twist) or which show telegraphing of construction below in face veneers or do not conform to tolerance limitations of AWI.
2. The warranty shall also include refinishing and reinstallation which may be required due to repair or replacement of defective doors.
3. Warranty shall be in effect during following period of time after date of substantial completion.

a. Solid Core Flush Interior Doors: Life of installation.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Protect wood doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with the "On-Site Care" recommendations of NWMA pamphlet "Care and Finishing of Wood Doors" and with manufacturer's instructions.

B. Provide protective coverings for shop finished doors at the factory prior to shipping. Use heavy paper cartons and mark with identification required for proper installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Eggers Industries.
2. V-T Industries
3. Weyerhauser Company

2.2 MATERIALS AND COMPONENTS:

A. General: Provide wood doors complying with applicable requirements of AWI Section 9 - Architectural Flush Wood Doors for kinds and types of doors indicated and as specified.

B. Face Panels: Manufacturer's standard 2 ply panels, unless otherwise indicated.

C. Exposed Surfaces: Provide kind shown or scheduled and as further specified. Provide same exposed surface material on both faces of each door, unless otherwise indicated.

D. Fire rated Doors: Provide exposed faces and edges to match nonfire rated doors in same area of building, unless otherwise indicated. Provide trim for openings (if any) which have been tested and listed for kind of door and rating indicated.

2.3 GENERAL FABRICATION REQUIREMENTS:

A. Openings: Cut and trim openings through doors and panels as shown. Comply with applicable requirements of referenced standard for kind(s) of doors required.

1. Light Openings: Factory cut openings. Trim openings for nonfire rated doors with solid wood moldings of stock profile.

2.4 INTERIOR FLUSH WOOD DOORS:

A. Solid Core Doors for Transparent Finish:

1. Faces: Specie, Red Oak, Grade A, plain sliced.
2. Grade: Custom
3. Construction: 5 Ply.
4. Core for all except Full Glazing : PC (Particleboard core.)
5. Bonding: Stiles and rails bonded to core, then entire unit abrasive planed before veneering.
6. Crossbands: 1/16 inch one piece tapeless and without voids.
7. Adhesives: Type I, hot press or high frequency types only.

B. Fire-Rated Solid Core Doors:

1. Faces and Grade: Provide faces and grade to match nonrated doors in same area of building, unless otherwise indicated.
2. Core: Manufacturer's standard core construction as required to provide fire-resistance rating indicated.
3. Edge Construction: Provide manufacturer's standard laminated edge construction for improved screw-holding capability and split resistance over edges composed of a single layer of treated lumber.
4. Blocking : Provide composite blocking designed to maintain fire resistance of door but with improved screw-holding capability of same thickness as core and with minimum dimensions as follows:

a. 5 inches top rail blocking.
b. 5 inch bottom rail blocking.
c. 5 - by - 18 inch lock blocks
d. 5 inch midrail blocking

2.5 SHOP FINISH:

A. Where shown as "prefinished," finish wood doors at factory or finishing shop.

(a) Color: provide a custom stain color to match sample provided by Architect

B. Comply with recommendations of AWI for factory finishing of doors, including final sanding immediately before application of finishing materials.

C. Provide Manufacturer's multi-component finish for specified grade of door.

2.6 PREFITTING AND PREPARATION FOR HARDWARE:

A. Prefit and premachine wood doors at factory.

B. Comply with tolerance requirements of NWWDA for prefitting. Machine doors for hardware requiring cutting of doors. Comply with final hardware schedules and door frame shop drawings and with hardware templates and other essential information required to ensure proper fit of doors and hardware.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer must examine door frames and verify that frames are correct type and have been installed as required for proper hanging of corresponding doors and notify Contractor in writing of conditions detrimental to proper and timely installation of wood doors. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

B. Install fire rated doors in corresponding fire rated frames in accordance with requirements of NFPA No. 80.

3.2 INSTALLATION:

A. Condition doors to average prevailing humidity in installation area prior to hanging.

B. Hardware: For installation see Division 8 "Hardware" section of these specifications.

C. Manufacturer's Instructions: Install wood doors in accordance with manufacturer's instructions and as shown.

D. Job Fit Doors: Align doors to frame for proper fit and uniform clearance at each edge and machine for hardware. Seal cut surfaces after fitting and machining.

1. Bevel nonfire rated doors 1/8 inch in 2 inches at lock and hinge edges.
2. Bevel fire rated doors 1/16 inch in 2 inches at lock edge.

D. Prefit Doors: Fit to frames and machine for hardware to whatever extent not previously worked at factory as required for proper fit and uniform clearance at each edge.

E. Clearance:

1. For nonfire doors provide clearances of 1/8 inch at jambs and heads; 1/8 inch at meeting stiles for pairs of doors; and 1/2 inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch clearance from bottom of door to top of threshold.
2. For fire rated doors, provide clearances complying with the limitations of the authority having jurisdiction.

F. Shop Finished Doors: Restore finish on edges of shop finished doors before installation, if fitting or machining is required at the job site.

3.3 ADJUST AND CLEAN:

A. Operation: Rehang or replace doors which do not swing or operate freely, as directed by Architect.

B. Finished Doors: Refinish or replace doors damaged during installation, as directed by Architect.

C. Protection and Completed Work: Advise Contractor of proper procedures required for protection of installed wood doors from damage or deterioration until acceptance of work.

END SECTION 08 14 00

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

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

1. Wall access doors.
2. Ceiling access doors.

B. Related Sections:

1. Division 4 Section "Unit Masonry" for building in anchors and grouting frames set in masonry construction.
2. Division 9 Section "Gypsum Drywall" for gypsum board walls and ceilings.
3. Division 9 Section "Acoustical Ceilings" for suspended acoustical ceiling systems.
4. Division 23 Section "Duct Accessories" for duct access doors.

1.3 QUALITY ASSURANCE:

A. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units which may vary slightly from sizes indicated.

1.4 SUBMITTALS:

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

1.5 COORDINATION:

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Provide access doors by one of the following:

1. Cesco Products.
2. J.L. Industries.
3. Karp Associates, Inc.
4. Milcor Div.; Inryco, Inc.
5. Nystrom, Inc.

6. The Williams Bros. Corporation of America.

2.2 MATERIALS:

A. Steel Sheet: ASTM A 366/A 366M commercial quality, cold rolled steel sheet with baked-on rust-inhibitive primer.

2.3 ACCESS DOORS:

A. General: Furnish each access door assembly manufactured as an integral unit, complete with all parts and ready for installation.

B. Steel Access Doors and Frames: Fabricate units of continuous welded steel construction, unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.

C. Flush Access Door with Exposed Trim/Frame:

1. Units consisting of frame with exposed trim, door, hardware, and complying with the following requirements:

a. Frame: 0.0598-inch (16 gage) thick steel sheet.
b. Door: 0.0747-inch (14 gage) thick steel sheet.
c. Trim: Flange integral with frame, 3/4-inch wide, overlapping surrounding finished surface.
d. Hinges: Continuous type.
e. Locks/Latches: Flush, screwdriver-operated cam. Provide manufacturer's standard number of latches based upon access door size indicated on drawings.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer must examine areas and conditions under which access doors are to be installed and must notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION:

A. Comply with manufacturer's instructions for installation of access doors.

B. Coordinate installation with work of other trades. Building in of anchors and grouting of frames is included in Division 4 Sections of these specifications.

C. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

3.3 ADJUST AND CLEAN:

A. Adjust hardware and panels after installation for proper operation.

END SECTION 08 31 13

SECTION 08 54 13 - FIBERGLASS REINFORCED POLYMER WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section included: Fiberglass Reinforced Polymer (FRP) windows of the following types:

1. Manufactured Unit Fixed Windows.

1.2 RELATED SECTIONS

A. Division 7 Section - Air Barriers.

B. Division 7 Section - Joint Sealants.

1.3 REFERENCES

A. American Architectural Manufacturers Association (AAMA):

1. AAMA 502 - Voluntary Specification for Field Testing of Windows and Sliding Doors.
2. AAMA 613 - Voluntary Performance Requirements and Test Procedures for Organic Coatings on Plastic Profiles.
3. AAMA 623 07 – Voluntary Specification, Performance Requirements and Test Procedures for Organic Coatings on Fiber Reinforced Thermoset Profiles
4. AAMA 624 07 – Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Fiber Reinforced Thermoset Profiles
5. AAMA 625 07 – Voluntary Specification, Performance Requirements and Test Procedures for Superior Performance Organic Coatings on Fiber Reinforced Thermoset Profiles

B. American Society for Testing and Materials (ASTM):

1. ASTM C 1036 - Flat Glass.
2. ASTM C 1048 - Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass.
3. ASTM E 283 - Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Difference Across the Specimen.
4. ASTM E 547 - Water Penetration of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Differential.

C. Window and Door Manufacturers Association (WDMA):

1. ANSI/AAMA/NWWDA 101/I.S.2 -97 - Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors.
2. AAMA/WDMA/CSA 101/I.S.2/A440-05 – Standard/Specification for windows, doors, and unit skylights
3. AAMA/WDMA/CSA 101/I.S.2/A440-08 – NAFS North American Fenestration Standard/Specification for windows, doors, and skylights

1.4 PERFORMANCE REQUIREMENTS

A. Air, Water and Structural Performance

1. Windows shall meet Rating specifications in accordance with ANSI/AAMA/NWWDA 101/I.S.2-97, AAMA/WDMA/CSA 101/I.S.2/A440-05, and AAMA/WDMA/CSA 101/I.S.2/A440-08
2. Window Air Leakage, ASTM E 283: Window air leakage when tested at 1.57 psf (25 mph) shall be 0.01 cfm/ft^2 of frame or less.
3. Window Water Penetration, ASTM E 547: No water penetration through window when tested under static pressure of 12.11 psf after 4 cycles of 5 minutes each, with water being applied at a rate of 8 gallons per hour per square foot.
4. Forced entry resistance not to exceed limits defined by the standard AAMA/WDMA/CSA 101/I.S.2/A440-05.
5. Field testing to verify compliance shall be performed on units of comparable size to gateway test sizes for designated Performance Classes as listed in Table 1 of Section 4.3 of AAMA/WDMA/CSA 101/I.S.2/A440-05

B. Thermal Performance

1. Windows shall meet whole-unit U-Value and SHGC Performance determined in accordance with NFRC 100.
    1. U-value: 0.14
    2. SHGC: 0.29

1.5 SUBMITTALS

A. Reference Section 01 33 00 – Submittals; submit following items:

1. Product Data: Submit manufacturer's product data, including installation instructions.
2. Shop Drawings: Include window schedule, window elevations, sections and details, and multiple window assembly details. Submit shop drawings as required, including location floor plans or exterior wall elevations showing all window openings, typical unit elevations, and full size detail sections of every typical composite member. Indicate the type of anchors, hardware, operators and other components not included in manufacturer's standard data. Include glazing details and standards for factory glazed units.
3. Samples:
    a. Color samples: Minimum 1 x 3 inch samples of Fiberglass with coating.
4. Quality Assurance / Control Submittals:
    a. Qualifications: Proof of manufacturers qualifications.
    b. U-Factor and structural rating charts required for AAMA and NFRC labeling requirements.
    c. Installation Instructions – ref. AAMA installation masters

B. Closeout Submittals: Reference Section 01 70 00 – Project Closeout: submit following items:

1. Maintenance instructions.
2. Special Warranties.

1.6 QUALITY ASSURANCE

A. Overall Standards: Comply with ANSI/AAMA 101.I.S.2, except as otherwise noted herein.

B. Qualifications:

1. Manufacturer Qualifications:

a. Minimum 5 years experience fabricating insulated glazing units using suspended film.

2. Provide test reports from an AAMA accredited laboratory certifying the performance of unit.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. Deliver materials to site undamaged in manufacturer's original, unopened containers and packaging, with labels clearly identifying manufacturer and product name. Include installation instructions.

B. Storage:

1. Protect the windows and accessories from the elements, construction activities, and other hazards until the project is complete.

a. Store materials in accordance with manufacturer's instructions.
b. Store materials off ground and under cover.
c. Protect materials from weather, direct sunlight, and construction activities.

C. Handling: Protect materials and finish during handling and installation to prevent damage.

1. Protect materials and finish during handling and installation to prevent damage.

1.8 WARRANTY

A. Commercial Special Warranty:

1. 10 year guarantee.
2. Guarantee windows against defects in materials and workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of specification Manufacturer:

Serious Energy
1250 Elko Dr.
Sunnyvale, CA 94089
Tel: 408-541-8000

Fax: 408-715-2560
Website: seriousenergy.com

B. Window Series:

1. 725 LP Series Fiberglass Windows

2.2 MATERIALS

A. Frame and Sash: Pultruded Fiberglass Reinforced Polymer, with color coating.

B. Hardware: Hardware having component parts which are exposed shall be of brass, aluminum, stainless steel or other non corrosive material(s) compatible with fiberglass and of sufficient strength to perform the functions for which they are used. Cadmium or zinc-plated steel, where used, shall be in accordance with ASTM A 165 or B 633. Nickel chrome-plated steel, where used, shall be in accordance with ASTM B 456. Inoperable windows will have no exposed hardware.

C. Weather-stripping: Weather-stripping conforming to AAMA 701or 702. Weather-stripping shall meet the requirements of the specifications as detailed in the appropriate test report. All weather-stripping shall be installed in specially-extruded ports and secured to prevent movement, shrinkage, or loss when removing sash either for cleaning or repair. Adhered weather-stripping shall not be allowed.

2.3 ASSEMBLY

A. Fabricate frames and sash with mitered and mechanically joined corners. Mitered seams shall be sealed thoroughly to prevent air or water penetration

B. Provide metal or composite reinforcement in sash or frame for attaching operating or locking mechanisms

C. Factory glazed, inside, with snap on PVC or Fiberglass glazing stops. Insulating glass units shall be reglazable without dismantling sash framing.

D. The windows shall be assembled in a secure and professional manner to perform as herein specified and to assure neat and weather tight construction. All main framing joints shall be sealed with sealants meeting the requirement of AAMA 803 or 809.

2.4 GLASS AND GLAZING

A. Overall IG thickness: nominal 1".

B. Insulated Glass Units: ASTM E774, Class A.,

C. Construction: Individual components shall comply with criteria specified in following paragraphs. Units shall be hermetically sealed and shall comply with ASTME 2190, Class CBA.

D. Components:

1. Glazing Unit Type Float:

a. Exterior layer to be clear low-e coated float glass of nominal 1/4" thickness; per ASTM C 1036: Type 1, Class 1, Quality q3; conforming to ASTM C 1376

b. Interior layer to be clear float glass of nominal 1/4" thickness; per ASTM C 1036: Type 1, Class 1, Quality q3
c. Gas Fill: Each cavity between glass and SCF shall be filled with an inert gas / air mixture containing a minimum of 90% Argon gas; units shall be equipped with gas-retention device for shipping

2. Glazing Unit Type Tempered:

a. Exterior glass to be Kind FT per ASTM C 1048, complying with CPSC 16CFR-1201; ANSI Z 97.1
b. Interior glass to be Kind FT per ASTM C 1048, complying with CPSC 16CFR-1201; ANSI Z 97.1
c. Gas Fill: Each cavity between glass and SCF shall be filled with an inert gas / air mixture containing a minimum of 90% Argon gas; units shall be equipped with gas-retention device for shipping.

3. Edge Sealants:

a. Primary: Polyisobutylene sealant complying with ASTM E 774 for glass-to-spacer seals
b. Secondary: Polyurethane sealant for perimeter moisture barrier
c. Seal durability: Perimeter seals shall maintain a hermetically-sealed, dehydrated condition for the duration of the product warranty.

2.5 FINISH (Exterior / Interior)

A. Frame and Sash colors: Bronze.

2.6 WINDOW TYPES:

A. Fixed Window 725 Series – Low Profile

1. Factory assembled and glazed Fixed (non-operating)

a. Type 1: Fixed glass unit, glazed with Type "Float" glass.
b. Type 2: Fixed glass unit, glazed with Type "Tempered" glass.

2. Frame:

a. Chambered, foam filled, pultruded fiberglass
b. Interior Exposed Surfaces: Factory applied coating
c. Overall Frame Depth: 3-1/4 inch

3. Sightlines: edge of frame to tip of glazing tower or glass line 1 ½"
4. Performance Class Structural

a. Heavy Commercial (CW) 50

2.7 INSTALLATION ACCESSORIES

A. Anchor Straps: Manufacturer's standard corrosion-resistant metal straps designed to lock into window frame.

B. Foamed-in-Place Plastic Insulation: low pressure, flexible, low conductance polyurethane for filling the shim space around the perimeter of the window, Hilti CF 812 Insulating Foam or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings in which windows will be installed.

1. Field verify that the existing window openings are within tolerance, plumb, level, clean, and provide a solid anchoring surface and substrate. Also confirm that the openings and are in accordance with approved shop drawings.
2. Verify that framing complies with method of installation
3. Verify that fasteners in framed walls are fully driven and will not interfere with window installation

B. Coordinate with responsible entity to correct unsatisfactory conditions. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

C. Commencement of work by installer is acceptable of substrate conditions.

3.2 INSTALLATION

A. Install windows in framed walls in accordance with AAMA 2400, and manufacturer's instruction

B. Install windows in accordance with manufacturer's instructions.

C. Install windows to be weather-tight and freely operating.

D. Maintain alignment with adjacent work.

E. Secure assembly to framed openings, plumb and square, without distortion.

F. Place interior seal around window perimeter to maintain continuity of building thermal and air barrier using insulating-foam sealant and air barrier accessories.

G. Fill the gap between the window frame and the rough opening with foamed in place plastic insulation to completely seal the perimeter of the window.

H. Seal window to exterior wall cladding with sealant and related backing materials at perimeter of assembly.

I. Do not remove temporary labels

3.3 CLEANING

A. Clean window frames and glass in accordance with Division 1 requirements.

B. Remove temporary labels and retain for Closeout Submittals.

C. Clean soiled surfaces and glass using a mild detergent and warm water solution with soft, clean cloths.

3.4 PROTECTION

A. Protect installed windows to ensure that, except for normal weathering, windows will be without damage or deterioration at time of substantial completion.

END SECTION 08 52 13

SECTION 08 70 00 - HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following and as indicated in the hardware schedule at the end of this section:

1. Hinges
2. Lock and Latch sets
3. Lock Cylinders and Keys
4. Closers
5. Stops
6. Bolts - Flush/Surface
7. Roller Latches
8. Weatherstripping
9. Thresholds
10. Silencers

B. Related sections:

1. Division 6 Section "Architectural Woodwork" for cabinet hardware.
2. Division 8 Section "Steel Doors and Frames"
3. Division 8 Section "Wood Doors"

1.3 QUALITY ASSURANCE:

A. Single Source Responsibility: Obtain each type of hardware from the same supplier.

B. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by UL or other testing and inspecting organization acceptable to authorities having jurisdiction.

1.4 SUBMITTALS:

A. Submit five copies of complete and detailed hardware schedule. Include product data on all hardware items being submitted.

B. The submitted schedule shall use symbol/letter designations and format shown on construction documents hardware schedule. The submitted schedule shall enumerate all scheduled openings in the same order as they appear on construction documents hardware schedule.

C. Submit five copies of proposed keying schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.

D. Submit sample of each item of finish hardware that differs from that specified.

E. Samples submitted may be used on the project and will be delivered to the building site where comparison will be made with other hardware furnished.

1.5 PRODUCT DELIVERY:

A. Mark each item as to contents and location in the building for which it is intended.

B. Ship prepaid the hardware templates and/or physical hardware, as required, to metal door and frame manufacturers and wood door manufacturers.

PART 2 - PRODUCTS

2.1 FINISH HARDWARE SCHEDULE:

A. Refer to schedule bound in the drawings for hardware requirements.

2.2 ANCHORS & FASTENERS:

A. Furnish as required and of proper size for the purpose for which it is intended.

B. Anchors in solid material shall be with machine screws in expansion shields. Furnish toggle bolts where walls are not solid material.

2.3 HINGES:

A. Non-removable pins on interior locked doors swinging out. Furnish non-rising pins on all other doors.

B. Steel hinges on all doors.

1. Exterior Hinge Finish: B.H.M.A. 629, stainless steel metal, satin (US32D).
2. Interior Hinge Finish: B.H.M.A. 626, satin chromium plated (US26D).

C. Number of Hinges:

1. Three on doors less than 89 inches.

D. Hinge size: Provide hinges of the following heights and weights for door sizes as indicated below:

1. 1 3/4 inches thick by 40 inches or less wide: 4 1/2 inches standard weight (0.134 inches)

E. Acceptable Manufacturers: Stanley, McKinney, Hager.

F. Hinge Types: Numbers are of Hager, unless otherwise specified.

TYPE	DESCRIPTION	MFR. NO.
H1	Standard weight ball bearing	BB1279 (interior); BB1191 (exterior)

2.4 LOCKSETS:

A. Design: Heavy Duty Commercial to match existing

1. Finish: B.H.M.A. 626, satin chromium plated (US26D).

B. Backset: 2-3/4 inches.

C. Furnish 2-3/4 inches high box type strikes with lip to project 1/8 inch beyond trim, frame or inactive leaf.

D. Acceptable Manufacturers: Sargent Manufacturing Co.; Schlage Lock Division, IR Security Technologies; Yale Security Inc.

E. Lock types/functions: Numbers are ANSI, unless noted otherwise.

TYPE	FUNCTION	A.N.S.I. No.
L1	Passage Latch	F75
L2	Bath/Bedroom Privacy Lock	F76
L3	Entrance/Office Lock	F82
L4&L5	Not Used.	
L5	Storeroom Lock	F86
L6	Fixed Lever Trim	--
L7	Electric Lock (**O.F.O.I**)	--

2.5 LOCK CYLINDERS AND KEYING:

A. Hardware supplier shall make arrangements to meet with Owner for the purpose of determining the various keying requirements.

B. Keying shall be a continuation of the existing system.

C. Provide new masterkey system for Project.

D. Master key all locks and cylinders.

E. Furnish five master keys for each master keyed set and three nickel silver change keys for each lock.

F. Stamp "DO NOT DUPLICATE" on all keys.

G. Furnish visual key control for all cylinders. Stamp proper key symbol on the bow of each key and on the face of the cylinder plug of each cylinder.

H. Cylinders shall be supplied by manufacturer of locksets.

I. Furnish manufacturer's standard 6-pin tumbler cylinders.

J. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel-silver. Aluminum, zinc, or plastic parts are not acceptable. Exposed finish shall match lockset, deadbolt, or exit device.

K. Deliver keys to the Owner via registered mail.

2.6 DOOR CLOSERS:

A. Size according to manufacturer's printed recommendation.

E. Provide arms, accessories, and metallic closer covers with the following finish:

1. B.H.M.A. 652, satin chromium plated (US26D).

F. Acceptable Manufacturers: LCN, Norton, Sargent, Rixson.

G. Closer types: Numbers are of LCN.

TYPE	DESCRIPTION	MFR. NO.
C1	Parallel Arm Closer with stop	4110-CUSH

2.7 STOPS:

A. Wall Mounted Stop

1. Stops and Bumpers: Cast brass or bronze with convex/concave rubber bumper.
2. Acceptable Manufacturer: Hager, NT Quality, Ives.

B. Overhead Stops

1. Size according to manufactures recommendations.
2. Acceptable manufacturers: Glynn-Johnson, Rixson.

C. Stop Finishes:

1. B.H.M.A. 626, satin chromium plated (US26D).

D. Stop types: Wall stop numbers are Ives: Overhead stop numbers are Glynn Johnson.

TYPE	DESCRIPTION	MFR. NO
S1	Wall Mounted (convex)	WS402CVX
S2	Overhead (concealed)	100S

2.8 BOLTS:

A. Manual

1. Furnish on top and bottom of inactive leaf with downset of top bolt approximately 72 inches above finished floor. Bottom bolt to be 12 inches above floor.
2. Furnish dustproof strike for all bottom bolts.
3. Acceptable Manufacturers: Ives, Sargent, Russwin, Corbin, Glynn-Johnson, NT Quality.

B. Flush Bolt Finishes:

1. B.H.M.A. 626, satin chromium plated (US26D).

C. Flush Bolt (and strikes) Types: Numbers are of Ives.

TYPE	DESCRIPTION	MFR. NO.
F1	Manual, wood doors	FB358 & DP2

2.9 ROLLER LATCHES:

A. Forged bronze adjustable spring loaded unit mortised into head frame.

B. Strike plate mortised into door.

C. Furnish one roller latch and strike plate for each door.

D. Roller Latch Finishes:

1. B.H.M.A. 625, bright chromium plated (US26).

D. Acceptable manufacturers: Ives or equal.

E. Roller Latch Type: Numbers are Ives

TYPE	DESCRIPTION	MFR. NO.
RL-1	Roller Latch	RL32

2.10 WEATHERSTRIPPING:

A. Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.

B. Acceptable Manufacturers: Reese Enterprises, Inc; Zero International; Pemko Manufacturing Co., Inc.; National Guard Products, Inc.

C. Weatherstrip sets: Numbers are of Reese Enterprises, Inc.

TYPE	DESCRIPTION	MFR. NO.
W1	Jamb and head weatherstrip	775A

2.11 THRESHOLDS:

A. Extruded aluminum extending to outside edge of door frames.

B. Acceptable Manufacturers: Reese Enterprises, Inc; Zero International; Pemko Manufacturing Co.,Inc.; National Guard Products, Inc.

C. Threshold types: Numbers are of Reese Enterprises, Inc.

TYPE	DESCRIPTION	MFR. NO.
T1	Extruded aluminum grooved tread, 5 inches wide	S405

2.12 SILENCERS:

A. Numbers are Ives.

B. Furnish three SR64 (metal frames) rubber silencers at strike jamb of each single door.

C. Furnish two SR64 (metal frames) rubber silencers at head jamb of double doors.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install all hardware in accordance with the manufacturer's recommendations.

B. Drill and tap hollow metal doors and frames for surface applied hardware.

C. Remove all applied hardware until painting is completed, then reinstall.

D. Locate hardware as follows unless shown otherwise on the drawings:

1. Hinges: Upper edge of top hinge 5 inches below frame head rabbet, lower edge of bottom hinge 10 inches above finished floor and space center hinges equal distance between top and bottom hinges.
2. Locksets: 40 inches above the finished floor to centerline of strike.
3. Stops: Install on door if wall condition is not applicable.
4. Flush Bolts: Edge mount.

E. Install door weatherstripping continuous without coping at hardware. Mount hardware to be located in the same location over the weatherstripping.

3.2 ADJUSTMENT:

A. Adjust all operating hardware in accordance with manufacturer's recommendations.

B. Deliver to Owner all installation and adjustment tools and two copies of each installation sheet furnished with hardware items.

END SECTION 08 70 00

SECTION 08 80 00 - GLASS AND GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes glazing for the following products, including those specified in other sections where glazing requirements are specified to this section:

1. Doors.
2. Glazing in frames in exterior walls.

B. See glass schedule at the end of this section.

C. Related sections:

1. Glass for factory-prefabricated window units is specified in another Division 8 section.
2. Framed mirror units are specified in the Division 10 Section - "Toilet Accessories".

1.3 QUALITY ASSURANCE:

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to the indicated for Project and whose work has resulted in construction with a record of successful in-service performance.

B. Applicable Standards:

1. Primary Glass Standard: ASTM C 1036.
2. Heat-Treated Glass Standard: ASTM C 1048.

C. Single Source Responsibility for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.

1.4 PERFORMANCE REQUIREMENTS:

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Confirm glass thickness by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thickness and in strengths required to meet or exceed design wind loads and lateral deflection standards.

1.5 SUBMITTALS:

A. Submit product data for each glass product and glazing material indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Products: Subject to compliance with requirements, provide products specified from the following approved Manufacturers:

1. Guardian Industries
2. OldCastle Glass, Inc.
3. Pilkington Glass, Ltd.
4. PPG Industries, Inc.

2.2 PRIMARY FLOAT GLASS:

A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Class 1, Quality q3 (glazing select), clear unless otherwise indicated.

2.3 HEAT-TREATED FLOAT GLASS:

A. Tempered Glass: Provide prime glass of color and type indicated, which has been heat treated (Kind FT) to strengthen glass in bending to not less than 4 to 5 times annealed strength, free of tong marks.

2.4 INSULATING GLASS:

A. Preassembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units.

B. Low-Emissivity Heat-strengthened, Coated Insulating Glass: Provide 2 sheets of glass as follows:

a. Outboard Lite: Clear float glass, Quality q3, 1/4 inch thick, Kind HS. Low-E coating on #2 surface, identical to PPG Solarban 60.
b. Air Space: 1/2 inch air space, with -20 degrees F (-29 degrees C) dew point, with manufacturers standard edge construction to maintain a hermetic seal.
c. Inboard Lite: Clear float glass, Quality q3, 1/4 inch thick, Kind HS.
d. Required Performance:

Visible light transmittance:	70%
Summer daylight U-Value:	.27
Winter nighttime U-Value:	.29
Solar Heat Gain Coefficient:	.38
Outdoor visible reflectance:	11%

2.5 GLAZING SEALANTS AND COMPONENTS:

A. General: Provide color of exposed sealant/compound indicated or if not otherwise indicated, as selected by Architect from manufacturer's standard colors or black if no color is so selected. Comply with manufacturer's recommendations for selection of hardness, depending upon the location of each application, conditions at time of

installation and performance requirements as indicated. Select materials and variations or modifications carefully for compatibility with surfaces contacted in the installation. Coordinate with other sections in Division 8 for glazing components that are supplied in those sections and supplement as required.

B. Acrylic Emulsion Glazing Sealant: Emulsion of acrylic, with or without latex rubber modification; compounded specifically for glazing; nonhardening, nonstaining and nonbleeding.

C. Butyl Rubber Glazing Sealant: Compound of polymerized butyl rubber and inert fillers, solvent based, 75 percent solids, complying with FS TT-S-001657; tack free in 24 hours., paintable, nonstaining.

D. Preformed Butyl Rubber Glazing Sealant: Compound of polymerized butyl rubber and inert fillers, with or without polyisobutylene modification, solvent based, 95 percent solids, formed and coiled on release paper; tack free in 24 hours., paintable, nonstaining; plain, preshimmed or reinforced as required for proper installation and setting of glass.

2.6 MISCELLANEOUS GLAZING MATERIALS:

A. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

B. Compressible Filler (Rod): Closed cell or waterproof jacketed rod stock of synthetic rubber or plastic foam, proven to be compatible with sealants used, flexible and resilient, with 5-10 psi compression strength for 25 percent deflection.

PART 3 - EXECUTION

3.1 STANDARDS AND PERFORMANCE:

A. Watertight and airtight installation of each glass product is required, except as otherwise shown. Each installation must withstand normal temperature changes, wind loading, impact loading (for operating sash and doors), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.

B. Protect glass from edge damage during handling and installation and subsequent operation of glazed components of the work. During installation, discard units with significant edge damage or other imperfections.

C. Comply with combined recommendations and technical reports by manufacturers of glass and glazing products as used in each glazing channel and with recommendations of Glass Association of North America (GANA) "Glazing Manual," except where more stringent requirements are indicated.

3.2 GLAZING:

A. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.

B. Clean and trim excess glazing materials from glass and stops or frames promptly after installation and eliminate stains and discolorations.

3.3 CURE, PROTECTION AND CLEANING:

A. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

B. Wash and polish glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Comply with glass product manufacturer's recommendations for final cleaning.

3.4 GLASS SCHEDULE:

A. See drawings for location of the following glass number designations.

G1 1/4 inch Clear float glass
G2 1/4 inch Tempered, clear
G3 1 inch Heat Strengthened Insulating glass

END SECTION 08 80 00

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Non-load bearing steel stud framing
2. Gypsum wallboard attached to steel framing
3. Ceiling Suspension Systems.
4. Adhesively bonded gypsum wallboard

B. Related sections:

1. Gypsum Sheathing: Refer to Division 6 Section- "Rough Carpentry."
2. Thermal insulation is specified in a Division 7 Section.

1.3 QUALITY ASSURANCE:

A. Fire Resistance Ratings: Where fire resistance rated gypsum board assemblies are indicated, assemblies shall comply with design designations as indicated in GA-600 "Fire Resistance Design Manual" or UL "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.

1.4 JOB CONDITIONS:

A. Maintain temperature at 50 degrees F or more for at least 48 hours prior to installation, during installation and until heating system is in operation or until building is occupied.

B. Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too quickly.

PART 2 - PRODUCTS

2.1 GYPSUM WALLBOARD (GWB):

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

1. Regular Gypsum Board, tapered edge, ASTM C-36.
2. Type "X" Gypsum Board, tapered edge, ASTM C-36.
3. Gypsum Sheathing, square edge, ASTM C-79.
4. Type "X" Water-Resistant Gypsum Backing Board, tapered edge, ASTM C-630.
5. Georgia Pacific DensShield Tile Backer, ASTM C 1178; ASTM C 630 for core.

B. Provide Type "X" gypsum wallboard where located in fire rated partitions.

2.2 METAL FRAMING COMPONENTS:

A. Provide 25 gauge metal studs except where noted or specified as 20 gauge. All studs not to exceed deflection limit of L/240.

B. Metal Studs: Channel type, nonloadbearing, formed from electro galvanized steel, designed for screw attachment of wall materials. Provide knockouts in web of each stud and 20 gauge runner tracks with minimum 1 inch high flange for headers and securing studs at top and bottom.

C. Hanger Wire: ASTM A641, Class 1 zinc coating, soft temper, 8 gage (0.162 inch) diameter.

D. Grid Suspension System for Interior Ceilings: ASTM C645, manufacturer's standard direct hung grid suspension system composed of main beams and cross-furring members that interlock to form a modular supporting network.

E. Resilient Channel: 1/2 inch deep Resilient Channel, 25 gauge galvanized steel.

F. Deep-Leg Deflection Track: ASTM C 645 top runner with 2 inch deep flanges.

G. Firestop Track: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire resistance rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Fire Trak Corp.; Fire Trak (attached to studs with Fire Trak Slip Clip.
2. Metal-Lite, Inc.; The System.

2.3 ACCESSORIES:

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

B. Screws through sheathing to be corrosion resistant.

C. Joint Tape: ASTM C 475.

1. Interior Gypsum Wallboard: Paper tape.
2. Tile Backing Panels: As recommended by panel manufacturer.

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

1. Interior Locations:

a. Prefilling: At open joints, open or beveled panel edges, and damaged surface areas, use setting type taping compound.
b. Embedding and First Coat: For embedding tape and first coat on joints, fasteners and trim flanges, use setting type taping compound.
c. Fill Coat: For second coat use drying type all purpose compound.
d. Finish Coat: For third coat use drying type all purpose compound.

E. Corner Bead: Galvanized steel; USG Dur-A-Bead No. 103, 1-1/4 inch flanges.

F. Metal Trim (Casing Bead): USG No. 200-A galvanized steel for face finishing with joint compound.

G. Expansion Joints: USG Control Joint No. 093, zinc with tape protected slot.

H. Adhesive: Type to bond upon impact.

I. Sealant: Water Resistant type sealant.

J. Acoustical Sealant: USG Acoustical Sealant; Tremco Acoustical Sealant; Presstite Acoustical Sealant.

K. Sound Insulation: Glass fiber or mineral wool equal to USG Thermafiber Sound Attenuation Blankets, Owens-Corning Noise Barrier Batts or Carney Sound Attenuation Blankets.

L. Sound isolation fillers - Provide rigid insulation fillers to close flutes in roof deck at the top tracks of stud framing in acoustical walls which run up to deck.

PART 3 - EXECUTION

3.1 INSTALLATION OF METAL FRAMING:

A. Space metal studs 16 inches on center. unless otherwise noted.

B. Install metal framing in accordance with ASTM C-754 unless otherwise specified.

C. Secure floor and ceiling runner tracks with appropriate fasteners 2 inches from each end and spaced not to exceed 24 inches on center.

D. Extend one runner to end of partition corner and butt other runner to it. Do not miter corners.

E. Position full length studs vertically engaging both floor and ceiling runner.

F. Provide two 20 gauge metal studs at each door jamb set in box configuration.

G. Anchor all studs located adjacent to door and window frames, partition intersections and corners to ceiling and floor runner flanges by screws.

H. Secure all other studs by stud clinching tool on both flanges of studs or by screws.

I. Provide a slip or cushion type joint of type as recommended by stud manufacturer where ceiling track is anchored to prevent transfer of structural loads or deflection to stud system.

3.2 CEILING SUSPENSION SYSTEM INSTALLATION:

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

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

3.3 WALL FURRING INSTALLATION:

A. Secure furring channel to substrate with anchors 24 inches on center staggered on opposite flanges.

3.4 ACOUSTICAL SEALING:

A. Seal entire perimeter of sound insulated walls with a 3/8 inch minimum bead of acoustical sealant placed at junction of framing system and abutting surface. Seal electrical boxes and any other openings or penetrations for an airtight seal.

3.5 SOUND INSULATION INSTALLATION:

A. Apply insulation with tight butt joints to fill all void spaces and obtain a continuous sound seal. Attach to back of gypsum board in cavity with fastener driven to straddle a drywall nail with minimum of one fastener in about 3 inches from each corner and one in center of each blanket.

3.6 GYPSUM WALLBOARD INSTALLATION:

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

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

C. Apply gypsum board first to ceiling and then to walls or partitions. Stagger end joints.

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

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

F. Stagger joints on opposite side of partition such that joints on both sides do not occur over the same framing member.

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

H. Space screws 12 inches on center in the field and edges for perpendicular application. Space screws 12 inches on center in the field and 8 inches on center along long edges for parallel application.

I. Space screws 12 inches on center in the field and 8 inches on center at edges of fire-rated construction.

J. Fasten each layer of double layer application for fire rated partitions with screws as specified for single layer.

K. Fasten first layer parallel to framing for non-rated double layer application same as specified for single layer. Apply second layer with adhesive. Provide temporary fasteners or bracing until adhesive sets.

L. Offset joints in face layer equal to one framing member space from and parallel to joints in base layer.

M. Adhesive apply gypsum board direct to substrates other than metal framing or gypsum wallboard in accordance with adhesive manufacturers instructions.

N. Provide gypsum board on one side of partition studs above ceiling to floor / roof deck above.

O. For sound and fire rated partitions, provide gypsum board on both sides of partition studs to underside of floor / roof deck above.

P. Where partitions intersect structural members projecting below the underside of floor / roof decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 inch to 3/8 inch wide joints to install sealant.

3.7 ACCESSORY INSTALLATION:

A. Apply all accessories in accordance with manufacturers instructions.

B. Install corner bead at all external corners.

C. Install metal trim (casing bead) where gypsum board butts other materials and at exposed edges or ends.

D. Where required control joints fall in door or window openings, provide control joints consisting of back to back metal trim (casing bead) from top of frame to ceiling at one corner of frame.

E. Provide partition control joints consisting of back to back metal trim (casing beads) spaced not more than 30 feet apart.

F. Provide ceiling control joints consisting of back to back metal trim (casing beads) spaced not more than 50 feet apart and maximum area of 2500 square feet.

G. Apply sealant to all cut edges and nail heads of water-resistant gypsum backing panel used as base for ceramic tile.

H. Apply regular gypsum board where scheduled gypsum board on ceilings of rooms with water-resistant gypsum backing panel walls.

I. Provide expansion joints where noted.

3.8 FINISHING INSTALLATION:

A. Finish all exposed joints, fastener heads, flanges of metal trim (casing beads), corner beads and other accessories with Joint Treatment in accordance with manufacturer's instructions. Finish of joints shall extend to floor to create a uniform surface whether room is scheduled to receive base or not. Finish board edges at floor to create a uniform surface whether room is scheduled to receive base or not.

B. Fill space between gypsum board and floor with joint compound if bottom edge of gypsum board is placed more than 1/4 inch above the floor.

C. Fill in space between outlet boxes and gypsum board with joint treatment at fire-rated partitions.

D. Provide Joint Treatment above suspended ceilings on sound and fire-rated partitions.

E. Levels of gypsum board finish: Provide the following levels of gypsum board finish per GA-214.

1. Level 1 for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-rated assemblies and sound -rated assemblies.

   a. Embed tape in joint compound.

2. Level 2 where panels form substrates for tile and where indicated.

   a. Embed tape in joint compound and apply first coat of joint compound.

3. Level 3 for gypsum board where indicated.

   a. Embed tape in joint compound and apply first and fill (second) coats of joint compound.

4. Level 4 for gypsum board surfaces, unless noted otherwise.

   a. Embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.

END SECTION 09 29 00

SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Ceramic Mosaic Tile.
2. Glazed Wall Tile.
3. Quarry Tile.
4. Paver Tile.
5. Metal edge strips and transitions.
6. Accessories.

1.3 QUALITY ASSURANCE:

A. Tile Manufacturing Standard: TCA 137.1. Furnish tile complying with Standard Grade requirements unless indicated otherwise.

B. Provide materials obtained from one source for each type and color of tile, grout and setting materials.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical information and installation instructions for materials required, except bulk materials. Include certifications and other data to show compliance with these specifications.

B. Samples: For initial selection of colors submit manufacturer's color charts consisting of actual tiles or sections of tiles showing full range of colors available, for each type of tile specified. Include samples of grout and accessories requiring color selection.

C. For verification purposes submit the following:

1. Samples for each type of tile and color required, not less than 12 inches square, on plywood or hardboard backing and grouted.
2. Full size samples for each type of trim, accessory and color.
3. 6 inches long samples of marble thresholds.
4. Samples of metal edge strip.

D. Certification: Furnish Master Grade Certificate for each type of tile, signed by manufacturer and Installer.

1.5 PRODUCT HANDLING:

A. Deliver packaged materials and store in original containers with seals unbroken and labels intact until time of use, in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Provide products by one of the following for each type of tile.

1. Glazed Wall Tile:

a. American Olean Tile Company
b. Dal-Tile Corporation
c. Florida Tile Industries, Inc.
d. Monarch Tile Manufacturing, Inc.
e. United States Ceramic Tile Company

2. Quarry Tile:

a. American Olean Tile Company
b. Dal-Tile Corporation
c. Summitville Tiles, Inc.

3. Porcelain Paver Tile:

a. Crossville Porcelain Stone/USA
b. Dal-Tile Corporation
c. EGESeramik
d. GranitiFiandre
e. Metropolitan Ceramics

2.2 TILE PRODUCTS:

A. Glazed Wall Tile:

1. Characteristics:

a. Manufacturer: Daltile
b. Field Tile Format: 6" x 6" (5-5/8" x 5-5/8" Actual.)
c. Finish: Semi-Gloss, cushion edge units.
d. Color: Refer to "Schedule Of Interior Finishes."

1. Test Results:

a. Water Absorption: ASTM C373: Less than 20.0%.
b. Breaking Strength: C648: Greater than 120-230 lbs.
c. Scratch Hardness: MOHS: 4.0-6.5
d. Coefficient of Friction: ASTM C1028, Wet: Greater then or equal to 0.50; Dry: Greater then or equal to 0.80.

B. Porcelain Paver Tile:

1. Characteristics:

a. Manufacturer: Daltile

b. Format: 12" x 12" (11-5/8" x 11-5/8" Actual.)
c. Pattern Series: City View.
d. Color: Refer to "Schedule Of Interior Finishes."

2. Test Results:

a. Water Absorption: ASTM C373: Less than 0.5%.
b. Breaking Strength: C648: Greater than 500 lbs.
c. Scratch Hardness: MOHS: 8.0
d. Coefficient of Friction: ASTM C1028, Wet: Greater then or equal to 0.60; Dry: Greater then or equal to 0.70.

C. Quarry Tile: Square edged; sizes, shapes and colors as shown.

3. Characteristics:

a. Manufacturer: Daltile
b. Field Tile Format: 6" x 6" (5-5/8" x 5-5/8" Actual.)
c. Finish: Quarry.
d. Color: Refer to "Schedule Of Interior Finishes."

4. Test Results:

a. Water Absorption: ASTM C373: Less than or equal to 3.0%.
b. Breaking Strength: C648: Greater than 350 lbs.
c. Scratch Hardness: MOHS: 7.0
d. Coefficient of Friction: ASTM C1028, Wet: Greater then or equal to 0.60; Dry: Greater then or equal to 0.80.

D. Trim And Special Shapes: When available in product line, provide rounded external corners and trim shapes at head, jamb and sill of openings, of same material and finish as field tile and as follows:

1. Base: Sanitary cove units.
2. Wainscot Cap: Surfaced bullnose or bullnose cap.
3. External Corners: Bullnose shapes, with a radius of not less than 3/4 inch, unless otherwise shown.
4. Internal Corners: Field butted square, except use square corner, combination angle and stretcher type cap.

2.3 MORTAR AND GROUT:

A. Portland Cement Mortar and Grout: ANSI A 108.1.

1. Color pigment: Mineral oxides, unaffected by lime, cement or weathering. Use when required to produce selected grout color.

B. Dry Set Mortar: Factory sanded Portland cement and additives; ANSI A 118.1. Use only the type of dry set mortar to set types of tile for which they are labeled.

C. Latex Portland Cement Mortar: Latex modified Portland cement dry set mortar; ANSI A 118.4.

D. Epoxy Mortar: Two component epoxy resin and hardener; ANSI A 118.3.

E. Latex-Portland Cement Grout: Proprietary compound composed of Portland cement with latex additive for a more flexible and less permeable grout. Color as selected by Architect from manufacturer's standard.

1. Provide product with latex additive which is compatible with latex additive in latex-Portland cement mortar.
2. Products offered by manufacturers to comply with requirements include the following:

   a. Hydroment Ceramic Tile Grout Joint Filler with Acrylic Latex Additive #425: Bostik.
   b. Latex Modified Floor Grout: L&M-Surco Manufacturing, Inc.(floors only)
   c. Laticrete Dry Bond: Laticrete International, Inc.

F. Epoxy Grout: Two-component epoxy grout complying with ANSI A118.3. Color as selected by Architect from manufacturer's standard.

1. Products offered by manufacturers to comply with requirements include the following:

   a. U-poxy/AAR II; Upco Company/USM Corporation
   b. LBM Epoxy Mortar and Grout; L&M-Surco Manufacturing, Inc.

G. Grout Sealer: Provide clear, water-based acrylic sealer. "CeramaSeal Grout Sealer" as manufactured by Bostik or Architect approved equal.

2.4 METAL EDGE STRIPS AND TRANSITIONS:

A. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic designed specifically for flooring applications, stainless steel; ASTM A 666, 300 Series exposed-edge material.

B. Tile to tile hard floor sloped transition: Ceramic Tool Company, CTC Tranz, 5/16 inch 3/8 inch tile height. Clear annodized finish.

C. Tile to carpet with lipped edge: Ceramic Tool Company, "CTC 716 BTC" Trim, 7/16 inch. Clear annodized finish.

2.5 ACCESSORIES:

A. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F per ASTM D 87.
2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

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.

PART 3 - EXECUTION

3.1 TILE INSTALLATION STANDARDS:

A. ANSI Standards: Comply with applicable requirements of the following, except as otherwise indicated.

1. ANSI A108.5: Tile installed with dry set Portland cement mortar or latex-Portland cement mortar.
2. ANSI A108.6: Tile installed with epoxy mortar.

B. Comply with manufacturer's instructions for mixing and installation of proprietary materials.

3.2 INSTALLATION:

A. Extend tile work into recesses and under or behind equipment and fixtures, to form a complete covering without interruptions, except as otherwise shown. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignments.

B. 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 that plates, collars or covers overlap tile.

C. Placement of coved wall base: Where coved wall base is provided, install base first and then field tile shall be set having top surface level with tangent point of cove radius. Do not set cove base on top of field tile.

D. Placement Methods: Install tile using the following setting beds as shown or scheduled. If not otherwise indicated, use Portland cement mortar where thickness and substrate permits.

1. Portland Cement Mortar Bed Installations:

a. Plastic mortar bed.
b. Dry set mortar over cured mortar bed.
c. Plastic mortar bed or dry set mortar over cured mortar bed at Contractor's option.

2. Thin-Set Installations:

a. Dry set Portland cement mortar or latex-Portland cement mortar.
b. Organic adhesive.
c. Conductive dry set Portland cement mortar.
d. Epoxy adhesive.

3. Chemically Resistant Installations:

a. Epoxy Mortar.
b. Furan Mortar.

E. Set marble thresholds in same type setting bed as field tile, unless otherwise indicated.

F. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are same size. Layout tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise shown.

G. Expansion and Control Joints: Provide openings for joints where shown and to comply with details, or, if not shown and detailed, to comply with recommendations in TCA "Handbook for Ceramic Tile Installation". Sealant work is specified in Division 7.

H. Grout:

1. Use commercial cement grout for grouting tile wall joints, unless otherwise shown.
2. Use a sand-Portland cement grout of one part Portland cement to 2 parts fine graded sand, and up to 1/5 part lime, for grouting quarry tile floors with joints 1/8 inch to 1/2 inch wide, unless otherwise shown.
3. For ceramic mosaic tile and other nonabsorptive tile with joints less than 1/8 inch wide, use one part Portland cement to one part extra fine sand.
4. Use epoxy grout where shown or scheduled.
5. Use furan grout where shown or scheduled.
6. Use dry set grout where shown or scheduled.
7. Use latex-Portland cement grout where shown or scheduled.
8. Use mastic grout where shown or scheduled.
9. Use pregrouted sheets where shown or scheduled. Field grout perimeter of individual sheets with same elastomeric material as used in factory pregrouted sheets.

I. Metal Edge Strips: Provide where shown and where exposed edge of ceramic tile flooring is to meet carpet, wood or other resilient floor covering.

J. Grout Sealer: Apply grout sealer in accordance with manufacturer's instructions.

3.3 CLEANING AND PROTECTION:

A. Cleaning:

1. Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but not sooner than 14 days after installation. Protect metal surfaces, cast iron and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
3. For tile areas grouted with furan resin, remove protective wax surfacing in accordance with tile manufacturer's instructions.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded or otherwise defective tile work.

C. Protection:

1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with Kraft paper or other heavy covering during construction period to prevent damage and wear.
2. Prohibit foot and wheel traffic from using tiled floors for at least 3 days after grouting is completed.

3. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END SECTION 09 30 00

SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Ceilings composed of acoustical panels and exposed suspension system.

1.3 QUALITY ASSURANCE:

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

1.4 SUBMITTALS:

A. Submit two samples of each acoustic material for approval.

1.5 JOB CONDITIONS:

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

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Provide products from the following:

1. Armstrong World Industries, Inc.
2. Certainteed
3. USG Interiors, Inc.
4. Capaul Corporation

2.2 MINERAL FIBER ACOUSTIC PANELS (ACP):

A. ACP-1: 24 inches x 24 inches x 3/4 inches mineral fiber lay-in panel, square edge, fine textured design, NRC 0.70, CAC 35, with washable white factory finish. Identical to USG #76575.

2.3 HUMIDITY RESISTANT ACOUSTIC PANELS (ACP):

A. ACP-2: 24 inches x 24 inches x 1/2 inch embossed vinyl faced, gypsum wallboard core, moisture resistant lay-in panel, CAC 35 with smooth textured white factory finish. Identical to USG #3260.

2.4 SUSPENSION SYSTEMS:

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

B. Provide all hanger inserts and anchors for supporting systems.

C. Color match exposed trim and accessories to suspension system.

2.5 EXPOSED GRID SUSPENSION SYSTEM:

A. Provide following system for acoustic panels type ACP-1:

1. 15/16 inch face, snap type of formed electro-galvanized steel main runners and cross tees. Finish of runners, cross tees and wall moldings to be factory applied of color to match the acoustic panel. Like Donn DX.

B. Provide following system for acoustic panels type ACP-2:

1. 15/16 inch face, snap type of formed electro-galvanized steel main runners and cross tees with aluminum cap. Finish of runners, cross tees and wall moldings to be factory applied of color to match the acoustic panel. Like Donn DXLA.

2.6 MISCELLANEOUS MATERIALS:

A. Hanging Wire: 12 gauge ASTM A-641 galvanized steel soft temper.

B. Hanging Wire for Humidity Resistant Acoustic Materials: 9 gauge aluminum or 12 gauge stainless steel.

C. Hold-Down Clips: Manufacturers standard concealed spring steel.

D. Acoustic Sealant: Heavy bodied, non-shrinking, nondrying, nonsag acoustical sealant.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Verify that conditions are proper for installation of acoustic materials.

3.2 GENERAL INSTALLATION:

A. Conform to installation requirements of ASTM C-636 and reflected ceiling plans.

B. Suspend hang wires from building structural members. Locate hanger near each end and spaced 4 feet-0 inches along runner or carrying channel. Level to 1/8 inch in 12 feet-0 inches.

C. Install acoustical units in a true and even plane, in straight line and courses laid out symmetrically about center lines of ceiling or panel with border units of half width or greater.

D. Install in accordance with the specifications and instructions of the manufacturer of the suspension system.

E. Space hangers, runners and tees to prevent deflection in excess of 1/360 of the span of any member.

F. Install wire hangers vertically.

G. Cut and fit all materials with straight, true, even lines.

3.3 EXPOSED GRID SYSTEM INSTALLATION:

A. Provide metal edge moldings where acoustical materials abut vertical surfaces or other materials. Secure 16 inches on center and 3 inches from each end. Miter all corners.

B. Provide hold down clips at time-rated ceilings and in areas of positive pressure relative to adjacent spaces, if manufacturers system requires clips.

C. Apply continuous acoustic sealant bead on back of vertical leg of wall edge molding before installing molding.

3.4 REPLACEMENT PANELS:

A. Furnish 20 additional pieces of each type and size of lay-in panels. Store in cartons in area where directed.

3.5 CLEANING:

A. Clean exposed surfaces of acoustical material and grid systems and touch up minor finish damage. Replace materials which can not be repaired to new condition.

END SECTION 09 51 00

SECTION 09 65 00 - RESILIENT FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Vinyl Sheet Flooring.
2. Rubber Tile Flooring.
3. Resilient Base.

1.3 QUALITY ASSURANCE:

A. Manufacturer:

1. Provide each type of resilient flooring and accessories as produced by a single manufacturer, including recommended primers, adhesives and sealants.
2. Wherever possible, provide required resilient flooring and accessories produced by a single manufacturer.

B. Fire Test Performance: Unless otherwise indicated, provide resilient flooring having the following classifications or properties when tested in accordance with the standard fire tests referenced below:

1. Critical Radiant Flux: Not less than the following rating as per ASTM E 648.

   0.45 watts per sq. cm.

2. Flame Spread: Not more than 75 as per ASTM E 84.
3. Smoke Developed: Not more than 450 as per ASTM E 84.
4. Smoke Density: Not more than 450 as per NFPA 258.

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

1.4 REFERENCES:

A. RFCI Vinyl Sheet Standard: SV-1, Resilient Floor Covering Institute Recommended Specification for Resilient Floor Covering Vinyl Plastic Sheet.

1.5 SUBMITTALS:

A. Product Data: Submit 2 copies of manufacturer's technical data and installation

instructions for each type of resilient flooring and accessory.

B. Samples:

1. Submit, for verification purposes, samples of each type, color and pattern of resilient flooring including accessories required indicating full range of color and pattern variation. Provide 6 inch x 9 inch samples of sheet flooring and 2-1/2 inches long sections of resilient flooring accessories.
2. For initial selection of colors and patterns submit, prior to above, samples in form of actual sections of resilient flooring including accessories showing full range of colors and patterns available for each type of resilient flooring required.

C. Certification for Fire Test Performance: Submit manufacturer's certification that resilient flooring furnished for areas indicated complies with required fire test performance and has been tested and meets indicated requirements.

D. Maintenance Instructions: Submit two copies of manufacturer's recommended maintenance practices for each type of resilient flooring and accessory required.

E. Replacement Material: After completion of work deliver to project site replacement materials from same manufactured lot as materials installed and as follows:

1. Sheet flooring, not less than 5 linear yards for each type, pattern and color installed.

1.6 JOB CONDITIONS:

A. Maintain minimum temperature of 70 degrees F in spaces to receive resilient flooring for at least 48 hours prior to installation, during installation and for not less than 48 hours after installation. Subsequently, maintain minimum temperature of 55 degrees F in areas where work is completed.

B. Install resilient flooring and accessories after other finishing operations, including painting, have been completed. Moisture content of concrete slabs and environmental conditions must be within limits recommended by manufacturer of products being installed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

4. Vinyl Sheet Flooring:

a. Armstrong Flooring.

5. Rubber Tile Flooring:

a. Nora Systems.

6. Wall Base:

b. Johnsonite, Division of Duramax, Inc.

MATERIALS:

A. Sheet Flooring:

1. Filled Vinyl Sheet Flooring: ASTM F1303, Class A backing, Grade 1, Type 1 and as follows:

a. Pattern and Design Style: Refer to "Schedule Of Interior Finishes."
b. Size: 72 inch wide rolls.
c. Overall Thickness: 0.080 inch gage.
d. Wearing Surface Thickness: 0.050 inch minimum
e. Backing: Inorganic mineral fiber type.
f. Welding Thread: Vinyl thread or rod as produced by manufacturer of sheet vinyl flooring and intended for heat sealing of joints to form "seamless" installation.

1) Color: Solid color to match field color of flooring.

7. Rubber Sheet Flooring: Solid, integrally colored rubber sheet flooring as follows:

a. Pattern and Design Styles: Refer to "Schedule Of Interior Finishes."
b. Size: 39.5 inches x 39.5 inches.
c. Thickness: .14 inch/1/8 inch gage.
d. Provide cold welded seams around perimeter of tile, at protrusions in flooring and at drains per Manufacturer's printed instructions.

B. Accessories:

1. Resilient Base: Provide rubber base complying with FS SS-W-40, Type I, with matching end stops and preformed or molded corner units, and as follows:

a. Height: 4 inches.
b. Style: Standard top set cove.

2. Resilient Edge Strips: 1/8 inch thick, homogeneous vinyl or rubber composition, tapered or bullnose edge, color to match flooring or as selected by Architect from standard colors available; not less than 1 inch wide.
3. Adhesives (Cements): VOC compliant, asbestos free, stabilized type as recommended by flooring manufacturer to suit material and substrate conditions.
4. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.
5. Leveling Compound: Latex type as recommended by flooring manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Broom clean or vacuum surfaces to be covered and inspect subfloor. Start of flooring installation indicates acceptance of subfloor conditions and full responsibility for completed work.

1. Use leveling compound as recommended by flooring manufacturer for filling small cracks and depressions in subfloors.
2. Perform moisture tests on concrete slabs to determine that concrete surfaces are sufficiently cured and ready to receive flooring.
3. Apply concrete slab primer, if recommended by flooring manufacturer, prior to

application of adhesive. Apply in compliance with manufacturer's directions.

3.2 INSTALLATION:

A. General:

1. Place flooring with adhesive cement in strict compliance with manufacturer's recommendations. Butt tightly to vertical surfaces, thresholds, nosing and edgings. Scribe around obstructions to produce neat joints, laid tight, even and straight. Extend flooring into toe spaces, door reveals and into closets and similar openings.
2. Maintain reference markers, holes or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.
3. Tightly cement edges to perimeter of floor around covers in floor.
4. Tightly cement flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks or other surface imperfections. Hand roll flooring at perimeter of each covered area to assure adhesion.

B. Sheet Flooring:

1. Lay sheet flooring to provide as few seams as possible with economical use of materials. Match edges for color shading and pattern at seams in compliance with manufacturer's recommendations, such as reversing adjoining sheets so that abutting edges are from same edge of roll.
2. Prepare seams in rubber sheet flooring in accordance with manufacturer's instructions for most inconspicuous appearance, sealing continuously with fluid applied sealant.

C. Accessories:

1. Apply resilient base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required. Install base in lengths as long as practicable with preformed corner units or fabricated from base materials with mitered or coped inside corners. Tightly bond base to backing throughout length of each piece with continuous contact at horizontal and vertical surfaces.
2. On masonry surfaces or other similar irregular surfaces fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
3. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring which would otherwise be exposed.

3.3 CLEANING AND PROTECTION:

A. Remove any excess adhesive or other surface blemishes using neutral type cleaners as recommended by flooring manufacturer. Protect installed flooring with heavy Kraft paper or other covering.

B. Finishing: After completion of project and just prior to final inspection of work, thoroughly clean floors and accessories.

C. Apply polish and buff, with type of polish, number of coats and buffing procedures in compliance with flooring manufacturer's instructions.

END SECTION 09 65 00

SECTION 09 65 66 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENT:

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

1.2 DESCRIPTION OF WORK:

A. Work includes furnishing of material and the complete installation of the synthetic sheet gym flooring with finish surface and lining as indicated on the drawings and as specified herein.

B. Related sections:

1. Concrete Substrate - Section 03 30 00

1.3 QUALITY ASSURANCE:

A. Applicator: Applicator shall be qualified and licensed by the manufacturer for the application of the system. Application shall be made under the direct, active, personal supervision of technical representatives of the manufacturer.

B. Manufacturer must have an existing installation, which has been in use for a full year, of this floor system and texture, available for inspection by Owner and acceptable to the Owner. Or, provide a five year bonded warranty against change in physical property of the flooring material under typical use for this facility. During warranty period, three cores are to be taken and patched as directed by the Owner. Cores are to be tested for physical properties as outlined in performance criteria and submittals. Areas found to be not in conformance to this specification shall be defined by further test cuts at the expense of the contractor and shall be completely removed and replace with approved procedures at no expense to the Owner.

C. The manufacturer must be able to demonstrate that flooring material can be repaired and patched so as to produce a uniform color, texture, texture depth, floor elevation, bond to substrate and bond to adjacent existing surface.

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

1.4 SUBMITTALS:

A. Color and finish samples: Submit four sets of three 12 inch square finish samples of complete color pallet for selection by Architect. Floor striping shall be included. Samples selected shall remain with the Owner and shall be used as a comparative control for the acceptance of the suppliers floor installation.

B. Installation Drawings: Submit complete layout drawings for court markings and installation details and other features of the installation.

C. Certified test data confirming the performance criteria of the product.

D. Description of recommended maintenance procedures and schedules which will assure continued performance of the installation to the highest standards possible. Maintenance of surface quality, resilience and appearance will be considered paramount.

1.5 JOB CONDITIONS:

A. Surface must be free of all foreign material, dirt, grease, paint or other bond breakers.

B. Surface must meet planarity requirements of a deviation not to exceed 1/8 inch under 10 foot straightedge.

C. Verify that concrete has been cured by water curing method without the use of chemical curing agents not compatible with flooring material.

1.6 GUARANTEE:

A. Provide a one year guarantee to repair or replace any and all portions of entire sheet flooring installation in the event of tears, separations and failure of bond to substrate occurring over floor joints (expansion and control joints), at bleachers in stored and open positions, and at joints abutting different floor surfaces or wall surfaces. Repairs or replacements must match existing flooring in color, texture, depth and bonding.

PART 2 - PRODUCTS

2.1 MANUFACTURER / PRODUCT:

A. For the purpose of establishing identification, design, function and quality standards, the Basis of Specification Product is:

1. Manufacturer: Burke Flooring Products, Division of Burke Industries.
2. Product: EcoFitness Fleckibles.
3. Composition: Poly-bonded granular postconsumer recycled black rubber with EPDM colored rubber flecks.
4. Thickness: 3/8 inch.
5. Width: 48 inches.
6. Color Style: Refer to "Schedule Of Interior Finishes."

B. Provide Basis of Specification Product or Architect approved equal.

2.2 ACCESSORY MATERIALS:

A. Adhesives: Adhesives shall be supplied by the flooring manufacturer and will be specially compounded to assure compatibility with the subsurface, and shall be applied in accordance with manufacturer's printed instructtions.

PART 3 - EXECUTION

3.1 SUBSTRATE PREPARATION:

A. Broom clean or vacuum surfaces to be covered and inspect subfloor. Start of flooring installation indicates acceptance of subfloor conditions and full responsibility for completed work.

1. Use leveling compound as recommended by flooring manufacturer for filling small cracks and depressions in subfloors.
2. Perform moisture tests on concrete slabs to determine that concrete surfaces are sufficiently cured and ready to receive flooring.
3. Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

B. Concrete Surfaces: Comply with ASTM C-811 unless otherwise indicated or required by manufacturer's instructions.

C. The building shall be dry and closed in. Permanent heating and/or air conditioning units must be operable in areas to receive floor material. Flooring installation shall not begin all subcontract work which would cause damage, dirt, dust or interruption of normal installation pace is completed. Slab temperature shall be maintained at a minimum of 65 degrees F., for 48 hours prior to the installation, during the installation and after the installation at no cost to the Installer. The installation area shall be closed to all traffic and under adequate lighting and adequate ventilation. Observe fire safety precautions - i.e., no smoking, open flame or equipment that could cause sparks.

3.1 INSTALLATION:

A. Place floor material in accordance with manufacturer's installation instructions.

END SECTION 09 65 66

SECTION 09 67 23 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. Definitions: Resinous flooring includes systems in which the topping component, consisting of resinous compounds or resin emulsions combined with selected fine aggregates, is continuously bonded to a supporting substrate to produce a thin, monolithic wearing surface.

B. Types of epoxy floor coating include the following:

1. Basecoat and Satin Topcoat, 15 mil minimum thickness.

1.3 QUALITY ASSURANCE:

A. Installer Qualifications: Engage an installer who has successfully completed within the last 3 years at least 3 resinous flooring applications similar in type to that to that of this project and who will assign mechanics from these earlier applications to this project, of which one will serve as lead mechanic.

B. Single Source Responsibility: Obtain primary resinous flooring materials including primers, resins, hardening agents, finish or sealing coats from a single manufacturer with not less than 3 years of successful experience in supplying principal materials for work of type described in this section. Provide secondary materials only of type and from source recommended by manufacturer of primary materials.

C. Underlayment: Resinous flooring manufacturer shall verify compatibility of underlayment material with resinous flooring.

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

1.4 SUBMITTALS:

A. Installer Qualifications: Submit documentation stating installer's capabilities to perform work.

1. Provide letter from manufacturer of products that installer is certified to install proposed products.
2. Provide list of applications, with references, of installations similar in size to this project and using proposed products.

B. Product Data: Submit manufacturer's technical data, installation instructions and general recommendations for each underlayment and resinous flooring material required.

1. Provide manufacturer's "Materials Safety Data Sheets" for owner review and approval for all components and materials used.
2. Provide certification indicating compliance of materials with requirements.

C. Samples: For selection by Architect, provide samples of manufacturer's available standard colors.

1.5 PROJECT CONDITIONS:

A. Environmental Conditions: Comply with resinous flooring manufacturer's directions for maintenance of substrate temperatures, ventilation and other conditions required to execute and protect work.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

B. Store materials to comply with manufacturer's directions to prevent deterioration from moisture, heat, cold, direct sunlight or other causes.

1.7 SPECIFIC PRODUCT WARRANTY:

A. Provide written two year warranty, signed by Contractor, Installer, and Manufacturer of resinous flooring, agreeing to replace/repair defective materials and workmanship, including flooring delamination from substrate and degradation of surface finish.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Specifications are based on products manufactured by Tennant Company, Minneapolis MN.

2.2 MATERIALS:

A. Basecoat: "Eco-MPE" thermosetting two component 100% solids epoxy resin matrix, Low VOC. 12 mils minimum thickness.

1. Physical Properties: Provide product in which Dry Film physical properties of Basecoat, when tested in accordance with standards referenced below, are as follows:

a.	Tensile Strength (ASTM D2370)	8000 psi
b.	Tensile Elongation (ASTM D2370)	5%
c.	Compression Strength (ASTM D695)	13,500
d.	Abrasion Resistance (ASTM D4060)	83.1
e.	Coefficient of Friction (ASTM D2047)	0.59-0.62
f.	Hardness (ASTM D 2240)	Shore D 75-80

B. Topcoat: "Eco-HTS 100" Satin Urethane, High solids 3-component topcoat, aliphatic, moisture cure urethane. 4 mils minimum thickness.

1. Physical Properties: Provide product in which dry film physical properties of topcoat, when tested in accordance with standards referenced below, are as follows:

a.	Tensile Strength (ASTM D2370)	6,250 psi
b.	Tensile Elongation (ASTM D2370)	6%
c.	Abrasion Resistance (ASTM D4060)	18
d.	Coefficient of Friction (ASTM D2047)	0.63
e.	Hardness (ASTM D 2240)	Konig, 171.3

C. Accessories:

1. Joint and Crack Filler: "Eco-EJF Ultra", Two-component epoxy. Product shall cure to a semi-rigid hard-rubber like resiliency designed to support joint edges in order to prevent deterioration and spalling of top coat.

a. Prepare joint and install joint filler in strict accordance with manufacturer's printed instructions.

D. Colors: As selected by Architect from manufacturer's standard offerings.

PART 3 - EXECUTION

3.1 SUBSTRATE PREPARATION:

A. General: Perform preparation and cleaning procedures in compliance with flooring system manufacturer's instructions for particular substrate conditions involved and as herein specified.

B. Concrete Surfaces: Comply with ASTM C-811 unless otherwise indicated or required by manufacturer's instructions.

3.2 MATERIALS PREPARATION:

A. Carefully mix and prepare materials used in resinous flooring system in compliance with manufacturer's instructions.

3.3 APPLICATIONS:

A. General: Apply each component of resinous flooring in compliance with manufacturer's directions to produce a uniform monolithic wearing surface of thickness indicated, uninterrupted except at divider strips, sawn joints or other types of joints (if any), indicated or required.

1. Provide 15 mil minimum total thickness.

3.4 CURING, CLEANING AND PROTECTION:

A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of curing process.

B. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and their method of their application. Remove temporary covering just prior to cleaning for final inspections.

C. Clean resinous flooring just prior to final inspections. Use materials and procedures recommended by resinous flooring manufacturer.

END SECTION 09 67 23

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes:

1. Surface preparation, painting, and finishing of new and existing exposed interior and exterior items and surfaces, unless otherwise noted or specified.

B. Surface preparation, priming, and finish coats specified in this section are in addition to shop-priming and surface treatment specified under other sections.

1.3 RELATED WORK:

A. Factory finished items will not require painting or finishing unless otherwise specified. Refer to technical sections for items to be furnished with a factory finish.

B. Prime coat will be factory applied on certain items. Refer to various technical sections for items to be furnished with a factory prime coat.

C. Nonferrous metal items will not require painting or finishing unless otherwise specified.

D. Identification of mechanical piping and electrical conduit will be done by respective contractors.

1.4 QUALITY ASSURANCE:

A. Materials shall be of manufacture, brand and quality as specified. Products of other manufacturers will not be accepted. Provide block fillers, primers and undercoat materials produced by the same manufacturer as the finish coats. All system components shall be compatible with one another and with substrates, as demonstrated by manufacturer based on testing and field experience.

B. Quality workmanship is required. Employ skilled craftsmen experienced in the use of the product involved with a record of successful service performance.

1.5 SUBMITTALS:

A. Product Data: Provide manufacturer's technical information, including label analysis and instructions for handling, storing and applying each coating material proposed for use. Include data for all components of each system specified, including fillers, primers, etc. Cross-reference each proposed material to finish system specified.

B. Certification: Provide certification by manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

C. Submit two sample panels of each type finish system for color and texture approval. Label each sample as to finish system.

D. Manufacturer Material Safety Data Sheets for all materials which are not water based shall be readily accessible at the construction site at all times that materials are present at the site.

1.6 DELIVERY, STORAGE & HANDLING:

A. Deliver paint ready-mixed to job site in manufacturer's original sealed containers with labels intact.

B. Store materials not in use in tightly covered containers in an approved well-ventilated area at a minimum ambient temperature of 45 degrees F. Maintain containers used in storage in a clean condition, free of foreign materials and residue. Provide adequate floor protection.

C. Remove oily or soiled rags and waste daily or store in sealed metal containers.

1.7 JOB CONDITIONS:

A. Paint only in areas which are clean and free of dust.

B. Do not apply materials until moisture content of surface is less than 12 percent as determined by moisture testing meter.

C. Do not apply materials on exterior surfaces during rainy or frosty weather or when temperature is below 50 degrees F.

D. Do not apply materials on surfaces while they are exposed to the sun.

PART 2 - PRODUCTS

2.1 COLORS AND FINISHES:

A. A schedule of selected colors will be supplied to the Contractor.

B. For estimating and bidding purposes, assume that each room will have one wall color and the ceiling painted a different color.

2.2 MATERIALS:

A. Provide all materials necessary, as recommended by coating manufacturer, for successful performance of coating system on indicated substrate, whether all components are specified herein or not. Materials shall include, but not be limited to, fillers, barrier coats, primers, undercoats, and finish coats.

B. Select manufacturer and product from following list using materials of same manufacturer for each finish. Provide special tinted primer in lieu of scheduled primer for accent or deep tone colors.

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TYPE "A" MATERIAL

+ Benjamin Moore..... Super Hide, 284

+ Diamond Vogel ..... PVA Primer/Surfacer, DU-1520
+ Hallman Lindsay ..... Pro-Kote Latex Wall Primer, 227
+ Mautz..... 60 One Hour Latex Primer
+ PPG..... 6-2 Quick Dry Primer Sealer
+ Pratt & Lambert..... SuPrime Interior Wall Primer, Z1004
+ Sherwin Williams..... Prep-Rite Latex Wall Primer B28W200

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TYPE "B" MATERIAL

+ Benjamin Moore..... Super Spec Latex Block Filler, 285
+ Diamond Vogel ..... Dia-Pro Acrylic Block Filler, BF-1515
+ Hallman Lindsay ..... Block Kote Latex Interior Block Filler, 184
+ Mautz..... 8-55 Latex Block Filler
+ PPG..... Masonry Block Filler 6-7
+ Pratt & Lambert..... Pro-Hide Silver Block Filler, Z8485
+ Sherwin Williams..... Prep-Rite Block Filler B25W25

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TYPE "D" MATERIAL

+ Benjamin Moore..... Acrylic Metal Primer, M04
+ Diamond Vogel ..... V-Cote 200 Maintenance Primer/Finish, MC-1501
+ Hallman Lindsay ..... Metalguard QD Alkyd Rust Inhibitive Primer, 330
+ Mautz..... 49-51 DTM Cryl through 49-54 DTM Cryl
+ PPG..... Speedhide Galvanized Primer 6-209
+ Pratt & Lambert..... SteelTech Acrylic Prime, Z190
+ Sherwin Williams..... Pro-Cryl Primer B66_310

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TYPE "E" MATERIAL

+ Benjamin Moore..... Alkyd Metal Primer, M06
+ Diamond Vogel ..... Cote-All Multi-purpose Alkyd Metal Primer, AZ-0400
+ Hallman Lindsay ..... Metalguard QD Alkyd Rust Inhibitive Primer, 330
+ Mautz..... 89-00 Industrial Enamel
+ PPG..... 6-204 Speedhide Zinc Chromate Primer
+ Pratt & Lambert..... SteelTech Rust Inhibitive Metal Primer, S4500 Series
+ Sherwin Williams..... S-W KemBond HS B50Z

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TYPE "L" MATERIAL

+ Benjamin Moore..... Super Spec Latex Eggshell Enamel, C274
+ Diamond Vogel ..... Permacryl Interior Latex Eggshell Enamel, DE-Series
+ Hallman Lindsay ..... Wonder Kote Latex Eggshell Enamel, 270
+ Mautz..... 43-00 Interior Latex Eggshell Enamel
+ PPG..... 6-411 Speedhide Latex Eggshell Enamel
+ Pratt & Lambert..... Accolade Velvet Interior 100% Acrylic Paint, PZ4000 Series
+ Sherwin Williams..... Pro-Mar Latex Eg-Shel Enamel B20

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TYPE "M" MATERIAL

+ Benjamin Moore..... Super Spec® Latex Flat, 275
+ Diamond Vogel ..... Pro-Plus Interior latex Flat, DF-Series
+ Mautz..... 100 Rubber Satin
+ PPG..... 80 Wallhide Flat Wall Paint
+ Pratt & Lambert..... Red Seal Interior Flat Wall Paint, Z2000 Series
+ Sherwin Williams..... ProMar Flat Latex B30

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TYPE "O" MATERIAL

+ Benjamin Moore..... Impervo High-Gloss Enamel #133
+ Diamond Vogel ..... Cote-All Multi-purpose Alkyd Gloss Enamel, AZ-Series
+ Hallman Lindsay ..... Duraguard Hi-Solids Urethane Gloss Enamel, 311
+ Mautz..... Industrial Enamel 89-11
+ PPG..... 54 Kine, Quick Dry Enamel
+ Pratt & Lambert..... Red Seal Interior/Exterior Oil Gloss Enamel, S1100 Series
+ Sherwin Williams..... Industrial Enamel 89-11

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TYPE "S" MATERIAL

+ Benjamin Moore..... Benwood Wood Grain Filler, 238
+ Pratt & Lambert..... Paste Filler
+ Sherwin-Williams ..... Sher-Wood Natural Filler D70T1

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TYPE "T" MATERIAL

+ Benjamin Moore..... Benwood Penetrating Stain, 234
+ Hallman Lindsay ..... Colortone Stain, 345
+ Mautz..... 95-00 Semi-Penetrating Stain
+ PPG..... 77-560 Rez Wood Tone Stain
+ Pratt & Lambert..... Tonetic Interior Wood Stain, Tinted or Ready-Mixed color
+ Sherwin Williams..... Wood Classics Oil Stain A49

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TYPE "U" MATERIAL

+ Benjamin Moore..... Super Spec® Sanding Sealer, C267
+ Diamond Vogel ..... Old Master's Polyeurethane Sanding Sealer
+ Hallman Lindsay ..... Spray Kote Sanding Wood Sealer, V-372
+ Mautz..... V-105 Sanding Wood Sealer
+ PPG..... 77-30 Rez Quick Dry Sanding Sealer
+ Pratt & Lambert..... Sanding Sealer, H40
+ Sherwin Williams..... Wood Classics Polyurethane Satin Varnish A67F1

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TYPE "V" MATERIAL

+ Benjamin Moore..... Benwood finishes varnish, 419
+ Diamond Vogel ..... Old Master's Satin Polyeurethane
+ Hallman Lindsay ..... Clearguard Urethane Satin Clear, V-368
+ Mautz..... V-234 Vi-Ray Urethane Stain
+ PPG..... 77-89 Rez Urethane Satin Clear
+ Pratt & Lambert..... Varmor Urethane Satin Clear Finish, R11 Series
+ Sherwin-Williams..... WoodClassics Polyurethane Satin Varnish A67F1

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TYPE "X" MATERIAL

+ Benjamin Moore..... Sweep-Up Spray Alkyd Eggshell, M52
+ Diamond Vogel ..... V-Tech 355 Low Odor/High Hide Dri-Mist Eggshell, LB-1604
+ Hallman Lindsay ..... Drop Dry Alkyd Interior Eggshell, 242
+ Mautz..... I-1050 Spray-Brite
+ PPG..... 6-161 Speedhide Dry Fog Spray
+ Pratt & Lambert..... Enducryl Oil Dry Fall Flat Z5900 Series, SG Z5900 Series
+ Sherwin Williams..... Super Save-Lite Alkyd Dryfall S/G B47W62

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TYPE "JJ" MATERIAL

+ Benjamin Moore..... .ArborCoat, Semi-solid, Deck and Siding Stain, #639.
+ Diamond Vogel ..... Grain Stain, Exterior Solid Latex Stain, BT-Series.
+ Hallman Lindsay ..... Kril-Tone, Solid Acrylic Color Stain, #185.
+ PPG..... Sun-Proof, Acrylic Solid Latex Stain, 77-1110 Series.
+ Olympic..... Maximum Solid Color Stain, 79601 Series.
+ Sherwin Williams..... WoodScapes, Exterior Acrylic Solid Color, A15 Series.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine substrates, areas and conditions under which painting will be performed for:

1. Defects which cannot be corrected by the procedures specified under Surface Preparation.
2. Compliance with paint application requirements.

B. Notify Contractor of surfaces requiring corrective work prior to painting.

C. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

D. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

E. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

3.2 SURFACE PREPARATION:

A. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

B. Protect, with suitable protective material, all finished surfaces and items, and existing surfaces and items not scheduled to be painted, that occur in close proximity of the area being painted.

C. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

D. Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

E. Clean and prepare each particular substrate by appropriate methods to proper condition to receive paint according to manufacturer's written instructions. Provide barrier coats over incompatible primers, or remove and reprime.

F. Clean and prepare existing, previously coated surfaces as recommended by manufacturer for specific condition and type of each existing coating.

G. Dull existing glossy surfaces by light sanding or washing with Tri-Sodium Phosphate.

H. Fill all holes, scratches, cracks or other irregularities with patching material.

I. Touch up abraded factory applied shop prime coat before applying finish coats. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

J. Prime metal corner and casing beads with an alkyd enamel underbody where water-thinned finish coats are specified.

K. Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.

L. Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove "white rust" by wire brushing. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

M. Clean aluminum surfaces with mineral spirits.

N. Clean wood surfaces of dirt, oil and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and remove sanding dust.

O. Prime, stain or seal wood to receive paint or transparent finish immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.

P. Seal tops, bottoms and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

Q. Remove loose particles and mortar spatters from concrete masonry units with a fiber bristle brush. Remove effloresence, dust, dirt, grease or other foreign substances as recommended by manufacturer.

3.3 MATERIALS PREPARATION:

A. Mix and prepare paint materials according to manufacturer's written instruction.

B. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

C. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

D. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint prime and each undercoat a lighter shade to simplify identification of each coat when multiple coats are applied. Tint prime and undercoats to match the color of

the finish coat, but provide sufficient differences in shade to distinguish each separate coat.

3.4 APPLICATION:

A. Apply materials by brush or roller in accordance with manufacturer's written instructions. Spray application will not be accepted unless specified otherwise herein. **Spray application will not be accepted unless approved by A/E prior to commencing. If spray application is allowed, each application shall be backrolled.** The number of coats and film thickness required are the same regardless of the application method.

B. Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

C. Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled and backroll.

D. Apply first coat to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

E. Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

F. Allow all coats to thoroughly dry before applying succeeding coats.

G. Sand lightly between each succeeding coat of enamel or varnish finish.

H. If undercoats, stains or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color and appearance. Give special attention to ensure edges, corners, crevices, welds and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, sheet, appearance and coverage. Cloudiness, spotting, holidays, lap, brush marks, runs, sags, ropiness, wrinkles, streaks, shiners, roller stipple, air bubbles, or other surface imperfections will not be acceptable.

J. Apply stain to wood in a uniform coat and wipe off.

K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.

L. Prime or seal top and bottom of wood doors same as face and edges of doors.

M. Finish exterior doors on tops, bottoms and side edges the same as exterior faces.

N. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, louvers and similar

components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.

3.5 EXTERIOR PAINTING:

A. Paint all surfaces listed under the exterior finish system schedule including but not limited to the following:

1. Items furnished with a factory applied prime coat.
2. Mechanical equipment and supports, ducts, vents and stacks when not indicated as exposed galvanized.
3. Sheet metal flashings not specified as factory prefinished.
4. Hollow metal doors and framing systems.
5. Metal lintels.

3.6 EXTERIOR FINISH SYSTEM SCHEDULE:

A. Finish coats of paint required on various surfaces are indicated as 1A + 2B which will require 1 coat of type A material and 2 coats of type B material.

1. Primed Ferrous Metals: 2O
2. Galvanized Metal: 1D + 2O
3. Wood (Cedar) - Exterior (Stained Solid): 2JJ

3.7 INTERIOR PAINTING:

A. Paint all rooms listed on "Room Finish Schedule" except as otherwise noted.

B. Paint all new surfaces and remodeled or patched areas in existing rooms to nearest vertical line break from floor to ceiling each direction with materials to match in color and sheen.

C. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

D. Paint galvanized metal ducts, electrical panels, conduit & boxes, pipe hangers and covered pipes in all rooms scheduled to be painted.

E. Paint interior surfaces of ducts where visible through registers or grilles with a flat nonspecular black paint.

F. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

G. Paint all prime coated metal, exposed surfaces not factory finished, prime coated mechanical and electrical equipment, uncovered pipe and pipe hangers.

H. Paint all surfaces listed under the interior finish system schedule.

I. Refer to "Room Finish Schedule" for location of finishes noted by types on the finish system schedule.

J. Surfaces not to be painted include the following:

1. Equipment identification, performance rating, name or nomenclature plates.

2. UL, WHI or FM code labels.
3. Concealed spaces including pipe spaces, duct shafts, elevator shafts, utility tunnels, furred areas, concealed areas and generally inaccessible spaces.

3.8 INTERIOR FINISH SYSTEM SCHEDULE:

A. Finish coats of paint required on various surfaces are indicated as 1A + 2B which will require 1 coat of type A material and 2 coats of type B material.

1. Gypsum Board (Latex Eggshell): 1A + 2L
2. Concrete Masonry Units (Latex Eggshell): 1B + 2L
3. Precast Concrete (Latex Flat): 1A + 1M
4. Precast Concrete (Latex Eggshell)L 1A + 1L
5. Galvanized Sheet Metal (Latex Eggshell): 1D + 2L
6. Primed Ferrous Metals (Solvent Semi-Gloss): 2O
7. Unprimed Ferrous Metal Primer: 1E
8. Metal Joists and Deck: 1X
9. Pipe Covering: 1A + 1L
10. Millwork (Filled - Stained - Clear): 1T + 1S (tinted) + 2V
11. Wood Doors (Stained - Clear): 1T + 1U + 1V

3.9 CLEANING:

A. At the end of each workday, remove from the premises all rubbish and accumulated material and leave work in clean condition.

B. Remove paint that has been misplaced on other surfaces.

C. Clean, repair and restore all damaged surfaces to their original finish.

END SECTION 09 91 00

SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following types of signs

1. Toilet room identification.

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's technical data and installation instructions for each type of sign required.

B. Shop Drawings: Submit shop drawings for fabrication and erection of specialty signs. Include plans, elevations and large scale details of sign wording and lettering layout. Show anchorages and accessory items. Furnish location template drawings for items supported or anchored to permanent construction.

PART 2 - PRODUCTS

2.1 IDENTIFICATION SYSTEMS:

A. Toilet Room Identification: Surface mount signs of type indicated, on wall adjacent to latch side of door at entrances to each toilet room indicating "MEN" or "WOMEN".

B. Produce acrylic signs which meet ADA and ANSI A117.1 requirements for raised copy letters and grade 2 Braille. Letters are to be 1" Helvetica medium. Each sign shall be 8 inch x 8 inch with rounded corners, and have accessibility pictorial.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install sign units and components at locations shown or scheduled, securely mounted with concealed theft resistant fasteners, unless otherwise indicated. Attach signs to substrates in accordance with manufacturer's instructions.

B. Install level, plumb and at proper height. Install square tube posts with one side perpendicular to the traffic direction. Cooperate with other trades for installation of sign units to finish surfaces. Repair or replace damaged units as directed by Architect.

END SECTION 10 14 00

SECTION 10 14 36 - POST AND PANEL SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. This Section includes the following:

1. Nonilluminated, single-sheet-type post and panel signs as indicated.

B. Related Sections include the following:

1. Division 1 Section "Temporary Facilities and Controls" for temporary Project identification and temporary informational and directional signs.
2. Division 3 Section "Cast-in-Place Concrete" for concrete fill in postholes.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide post and panel signs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Wind Loads: Determine loads based on a uniform pressure of 20 psf, acting in any direction.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include manufacturer's written instructions for maintaining and cleaning sign surfaces.

B. Shop Drawings: Show fabrication and installation details for post and panels signs.

1. Include plans, elevations, and sections of typical members and other components. Show anchors, reinforcement, accessories, layout, and installation details.
2. Show true depiction of text and graphics as it will appear on all signs

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of alloy 5005-H15.

B. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500, Grade B, hot-dip galvanized after fabrication with a minimum of 2.0 oz. zinc / sq. ft. of surface area conforming to ASTM A123.

2.2 ACCESSORIES

A. Fasteners: Use concealed fasteners fabricated from metals that are noncorrosive to sign material and mounting surface.

B. Anchors and Inserts: Use stainless-steel or hot-dip galvanized anchors and inserts. Use torque-controlled expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete.

C. Concrete for Postholes: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 2500 psi unless otherwise indicated.

2.3 POSTS

A. General: Fabricate posts to lengths required for mounting method indicated.

1. Direct-Burial Method: Provide posts 36 inches longer than height of sign to permit direct embedment in concrete foundations.

B. Aluminum Posts: Manufacturer's standard 0.125-inch-thick, extruded-aluminum tubing, with vertical slots to engage sign panels. Provide stop blocks in slots to hold panels in position. Include post caps, fillers, spacers, junction boxes, access panels, and related accessories required for complete installation.

2.4 SIGN PANELS

A. General: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.

1. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
2. Increase metal thickness or reinforce with concealed stiffeners or backing materials as needed to produce surfaces without distortion, buckles, warp, or other surface deformations.
3. Continuously weld joints and seams, unless other methods are indicated; grind, fill, and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.
4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

B. Unframed Single-Sheet Panels: Provide unframed single-sheet sign panels with edges mechanically and smoothly finished.

1. Panel Finish: Manufacturer's standard semigloss finish with UV inhibitors.
2. Edge Condition: square.
3. Corner Condition: radius.

2.5 GRAPHICS

A. Accessible Parking Signs: Comply with ADA and Department of Transportation requirements. Provide signs as indicated on site plan corresponding to space type:

1. Van Accessible Space

B. Provide informational and traffic control signage as indicated in the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Excavation: In firm, undisturbed or compacted soil, drill or using a post-hole digger, hand-excavate holes for each post to minimum diameter recommended by sign manufacturer, but at least four times the largest post cross-section.

B. Setting Posts: Center and align posts in holes.

1. Protect portion of posts above ground from concrete splatter. Place concrete and vibrate or tamp for consolidation. Check post for alignment and hold in position until concrete has achieved its initial set.

C. Install sign units and components at locations shown or scheduled, securely mounted with concealed theft resistant fasteners, unless otherwise indicated. Attach signs to substrates in accordance with manufacturer's instructions.

D. Install signs level, plumb, and at height indicated, with surfaces free from distortion or other defects in appearance.

3.2 CLEANING

A. At completion of installation, clean soiled surfaces of sign units according to manufacturer's written instructions.

END SECTION 10 14 36

SECTION 10 28 00 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. This section includes the following:

1. Toilet Accessories:

a. Paper towel dispensers (PTD)
b. Framed mirror units (MIR).
c. Toilet paper dispensers (TPD)
d. Sanitary Napkin Disposal (SNR).
e. Grab bars (GB).
f. Soap dispensers (SD).
g. Folding shower seat.
h. Shower curtain rods.
i. Shower curtain and hooks.
j. Robe hook (RH).
k. Mop and broom holder (MH).

1.3 QUALITY ASSURANCE:

A. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.

B. Accessory Locations: Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

C. Products: Provide products of same manufacturer for each type of accessory unit and for units exposed in same areas, unless otherwise acceptable to Architect.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical data and installation instructions for each toilet accessory.

B. Samples: Submit full size samples of units to Architect for review of design and operation. Acceptable samples will be returned and may be used in the work.

C. Setting Drawings: Provide setting drawings, templates, substrate preparation, instructions and directions for installation of anchorage devices in other work.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Provide each type of toilet accessory required as manufactured by one of the following:

A&J Washroom Accessories, Inc.
American Specialties, Inc.
Bobrick Washroom Equipment, Inc.
Bradley Corporation
General Accessories Manufacturing Co.
Mckinney / Parker Washroom Accessories

2.2 MATERIALS:

A. Stainless Steel: ASTM Type A66, 304, with No. 4 finish (satin), 0.0312 inch minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19, leaded and unleaded flat products, ASTM B 16, rods, shapes, forgings and flat products with finished edges; ASTM B 30, castings.

C. Sheet Steel: ASTM A366 Cold rolled, commercial quality ASTM A 366, 0.039 inch minimum nominal thickness, unless otherwise indicated. Surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 653, G60.

E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.

F. Baked Enamel Finish: Factory applied, gloss white, baked acrylic enamel coating.

G. Mirror Glass: ASTM C 1036, Type I, Class I, Quality q2, 1/4 inch thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

H. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

I. Fasteners: Screws, bolts and other devices of same material as accessory unit , tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION:

A. General: Stamped names or labels on exposed faces of toilet accessory units are not permitted, except where otherwise indicated. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicated manufacturer's name and product model number.

B. Locking: Wherever locks are required for a particular type of toilet accessory, provide same keying throughout project. Furnish two keys for each lock.

C. Surface Mounted Toilet Accessories: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous piano hinge or minimum of two 1-1/2 inch pin hinges of same metal as unit cabinet. Provide concealed anchorage wherever possible.

D. Surface Mounted Toilet Accessories: Provide accessories which are A.D.A. compliant.

E. Paper Towel Dispensers (PTD)

1. Roll type pull and tear towel dispenser to match City of Madison standard.
2. Approved unit: Bay West brand by Wausau Paper Company, black color.
2. Contractor to coordinate location of blocking in wall if required.

F. Framed Mirror units (MIR):

1. Standard Stainless Steel Framed Mirror Units: Fabricate frame with channel shapes not less than 0.0375 inch, with square corners carefully mitered to hairline joints and mechanically interlocked. Provide glass edge protection material within frame and mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.

    a. Metal framed 36 inch x 36 inch mirror.
    b. Basis of specification: Bobrick, B-165 3636 or equal.
    c. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

G. Toilet Paper Dispensers (TPD)

1. 3-roll toilet tissue dispenser to match City of Madison standard.
2. Approved unit: Bay West model 80300 by Wausau Paper Company, black color
2. Contractor to coordinate location of blocking in wall if required.

H. Sanitary Napkin Receptacle (SNR):

1. Surface Mounted Stainless Steel Type: Fabricate with seamless exposed walls, tightly self-closing top cover embossed with "Napkin Disposal." Provide locking bottom panel with continuous stainless steel piano hinge.

I. Grab Bars (GB):

1. Stainless Steel Type: Provide grab bars with wall thickness not less than 18 gage and as follows:

    a. Mounting: Concealed, manufacturer's standard flanges and anchorages.
    b. Gripping Surfaces: Manufacturer's standard nonslip texture.
    c. Heavy-Duty Size: 1-1/2 inch outside diameter, with wall thickness not less than 16 gage.

J. Soap Dispensers (SD):

1. Liquid Soap, Vertical Tank Type: Fabricate for surface mounting, sized for 40 fluid ounce minimum capacity. Provide stainless steel piston, springs and internal parts designed to dispense liquid soap or lather in measured quantity by pump action. Provide cover in stainless steel, with unbreakable window-type refill indicator.

K. Folding Shower Seat:

1. Provide heavy-duty hinged seat designed to fold up against wall when not in use with stainless-steel support braces, hinges, frame, and fasteners; of all-welded construction;

2. Configuration: L-shaped seat, transfer type, designed for wheelchair access.
3. Seat material: Phenolic or polymeric composite of slat-type construction. Color as selected by Architect from manufacturer's full range.

L. Shower Curtain Rods:

1. Stainless Steel Type: Fabricate with outside diameter not less than 1 inch and wall thickness not less than 20 gage; furnish flanges to match rod.
2. Chromium Plated Brass Type: Fabricate with outside diameter not less than 1-1/4 inches and wall thickness not less than 18 gage; furnish flanges to match rod.

M. Shower Curtain and Hooks:

1. Antibacterial Shower Curtain: Minimum 10-oz., nylon-reinforced vinyl or 0.008 inch thick vinyl material with integral antibacterial agent and corrosion-resistant grommets at minimum 6 inches on center through top hem.
2. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

N. Robe Hook (RH):

1. Double-prong Unit: Stainless-steel, double-prong robe hook with rectangular wall bracket and backplate for concealed mounting. Overall projection shall not exceed 4 inches from face of wall.

O. Mop and Broom Holder (MH):

1. Mop and Broom Holder: 36-inch-long unit fabricated of minimum nominal 0.0375-inch-thick, stainless-steel hat channel with four spring-loaded, rubber, cam-type, mop/broom holders.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer must examine substrates, previously installed inserts and anchorages necessary for mounting of accessories and other conditions under which installation is to occur and must notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION:

A. Install accessory units in accordance with manufacturer's instructions, using fasteners which are appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.3 ADJUST AND CLEAN:

A. Adjust accessories for proper operation and verify that mechanisms function smoothly.

B. Clean and polish all exposed surfaces after removing protective coatings and temporary labels.

END SECTION 10 28 00

SECTION 12 24 00 - ROLLER WINDOW SHADES

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. This Section includes roller shades and motorized shade operators.

B. Related Sections include the following:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Division 26 Sections for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized shade operation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

1. Motorized Shade Operators: Include operating instructions.
2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.

1. Motorized Shade Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
2. Wiring Diagrams: Power, system, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension system members and attachment to building structure.
2. Ceiling-mounted or penetrating items including light fixtures, air outlets and inlets, speakers, sprinklers, recessed shades, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
3. Shade mounting assembly and attachment.

4. Size and location of access to shade operator, motor and adjustable components.

D. Samples for Verification:

1. For the following products:

a. Shade Material: Not less than 3 inches square, with specified treatments applied. Mark face of material.
b. Shade Material: Not less than 12-inch- square section of fabric, from dye lot used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of material.

E. Window Treatment Schedule: For roller shades.

F. Product Certificates: For each type of roller shade, signed by product manufacturer.

G. Qualification Data: For Installer.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer, for each type of roller shade.

I. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:

1. Methods for maintaining roller shades and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. Operating hardware.
4. Motorized shade operator.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed installation of roller shades similar in material, design and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Resistance Ratings: Passes NFPA 701.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Product Standard: Provide roller shades complying with WCMA A 100.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 ROLLER SHADES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product specified or a comparable product:

1. Manufacturer: Springs Window Fashions.

B. Shade Band Material:

1. Color, Texture and Weave: SWF Contract Style 2000, Charcoal/Chestnut
2. Bottom Hem: Straight.
3. Trim: As indicated by manufacturer's designation for style and color.

C. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method for attaching shade material. Provide capacity for one roller shade band(s) per roller.

D. Direction of Roll: Regular, from back of roller.

E. Mounting Brackets: Galvanized or zinc-plated steel for ceiling pocket installation and fascia end caps, fabricated from steel finished to match fascia or headbox for surface installation.

F. Surface-Style Headbox: U-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; with a bottom cover consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing shade roller, brackets, and operating hardware and operators within. Surface mounting to wall is required in locations indicated.

G. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.

H. Mounting: Both Inside jambs and recessed in ceiling pocket in locations where indicated on Drawings, mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

I. Powered Shade Operation: Motorized operator.

2.2 ROLLER SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lifting Mechanism: With permanently lubricated moving parts.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
2. Shade Units Installed in Ceiling Pocket: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, headbox, roller, and operating hardware and for hardware position and shade mounting method indicated.

E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

F. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range, unless otherwise indicated.

2.3 MOTORIZED ROLLER SHADE OPERATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide MechoShade or a comparable product by one of the following:

1. Manufacturer: Springs Window Fashions.

B. General: Provide factory-assembled motorized shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by shade manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.

C. Comply with NFPA 70.

D. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

E. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection, brake, permanently lubricated bearings, and limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.

1. Service Factor: According to NEMA MG 1, unless otherwise indicated.
2. Motor Characteristics: Single phase, 24V, 60 Hz.
3. Motor Mounting: Within manufacturer's standard roller enclosure.

F. Position of Motor and Electrical Connection: Left side of roller, as determined by hand of user facing shade from inside, unless otherwise indicated on Drawings.

G. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following devices for remote-control activation of shades:

1. Group Control Stations: Provide group control activated by momentary-contact, three-position, rocker-style, wall switch-operated control station with open, close, and center off functions for single-switch group control. Provide control and switches for a minimum of two (2) groups.

a. Color: As selected by Architect from manufacturer's standard offerings.

H. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.

I. Operating Function: Stop and hold shade at any position.

J. Operating Features: Include the following:

1. Group switching with integrated switch control; single face plate for multiple switch cut-outs. Stack 2 switches vertically.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Connections: Connect motorized operators to building electrical system.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain roller shades.

END OF SECTION 12 24 00

SECTION 12 93 13 - BICYCLE RACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. Extent of bicycle racks is indicated on drawings.

1.3 QUALITY ASSURANCE:

A. Reference Standards

1. Installer Qualifications: An experienced installer who has completed installation of bicycle racks similar in material, design, and extent to that indicated for this project and whose work has resulted in construction with a record of successful in-service performance.
2. Manufacturer Qualifications: A firm experienced in manufacturing bicycle parking racks similar to those required for this project and with a record of successful in-service performance.
3. Source Limitations: Obtain each color, finish, shape and type of bicycle rack from a single source with resources to provide components of consistent quality in appearance and physical properties.
4. Product Options: Drawings indicate size, shape and dimensional requirements of bicycle racks and are based on the specific system indicated.
5. Refer to Section 01811: Sustainable Design Requirements.

B. Submittals

1. Product Data: Include physical characteristics such as shape, dimensions, bicycle parking capacity and finish for each bicycle rack.
2. Shop Drawings: Show installation details for each bicycle rack.
3. Samples for Verification: Submit finish samples for review and verification. Include recommended methods for repairing damage to the powder coat finish.
4. Maintenance Data: For each bicycle rack.

C. Delivery, Storage and Handling

1. Store bicycle racks in original undamaged packages and containers until ready for installation.
2. Handle bicycle racks with sufficient care to prevent any scratches or damage to the finish

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

A. Saris Parking Products, Inc. 5253 Verona Rd Madison, Wisconsin 53711, 1-800-783-7257.

B. Approved Equal.

2.2 MATERIALS

A. Rack shall be constructed of ASTM A5133, 12 ga. X 1.66 electric welded steel tubing.

B. Powder Coating: Black double coated polyester standard, 9 other colors available at additional cost.

1. Color: Black.

2.3 APPROVED PRODUCTS:

A. 6900 U-Rack Series. The bicycle parking rack shall be the 6902 bicycle rack as manufactured by Saris Parking Products, Inc. Frame shall be constructed of 12 gauge x 1.66 electric welded steel tubing. Below Grade option: extends 11" below surface, each leg has 10" x 7/16" steel rod extending through pipe for extra support.

B. Approved Equal.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Handle and install bicycle racks in accordance with manufacturer's recommendations and installation instructions.

B. Set bicycle racks secured to construction, level and true to line, in correct relationship to adjacent materials.

END SECTION 12 93 13

DIVISION 21 – FIRE PROTECTION
SECTION 21 05 10 – GENERAL FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Provide all labor, materials, equipment, tools and services for a complete fire protection system as indicated and in specifications. System shall include post indicator valve, fire protection service piping, distribution piping to sprinkler heads, test stations, alarm check valves, alarms, controls, standpipe piping from distribution piping to hose valves and drain piping for sprinkler piping drainage.

B. It is not the intention of these specifications to enumerate each and every item for a complete system, but it shall be distinctly understood that this Contractor is to install the sprinkler system complete in all detailed parts subject to the rules and requirements of the National Fire Protection Agency (NFPA), the Municipal Ordinances, State Requirements and the authority having jurisdiction.

1.3 QUALITY ASSURANCE

A. Products and work shall comply with ANSI/NFPA 13, "Installation of Sprinkler Systems"; ANSI/NFPA 14, "Installation of Standpipe and Hose Systems", ANSI/NFPA 231, Standard for General Storage, and local Fire Department/Marshall regulations.

B. Provide products with appropriate FM and UL labels.

C. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components.

1.4 WORKING DRAWINGS

A. Working drawings of the entire system showing the piping, locations of each sprinkler head, valves, drains, alarms, etc. shall be submitted by this Contractor to the Architect after approval of the above agencies has been secured.

B. In preparing the working drawings, the Contractor shall cooperate with all other trades involved with the sprinkler work and all pipe runs and sprinkler locations shall be coordinated with all other trades to avoid conflict with ducts, pipes, lighting, etc.

1.5 SYSTEM DESCRIPTION

A. Fire protection system is a "Wet-Pipe" system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by fire.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's data sheets showing dimensions and materials.

B. Maintenance Data: Submit maintenance instructions and spare parts lists. Include this information in maintenance manuals.

C. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable Victaulic style or series number.

D. SUBMITTAL SHALL BE APPROVED BY AUTHORITY HAVING JURISDICTION PRIOR TO SUBMISSION TO A/E. Obtain departmental approval prior to beginning construction. Pre-submittal to A/E for sensitive areas requiring architectural coordination is permitted.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION PIPING

A. Provide piping materials of factory fabricated piping products of sizes, types, pressure and temperature ratings, and capacities as indicated below. Where not indicated, provide proper selection as determined by industry standards and governing regulations. Where more than one type of materials or products is indicated, selection is Installer's option.

B. Interior Piping: Pipe or tube used in sprinkler systems shall meet or exceed the standards outlined in NFPA 13 "Standards for the Installation of Sprinkler Systems."

C. Piping Materials:

1. Copper Tubing -Drawn Temper: ASTM B 88, Type L.

2. Steel Pipe: ASTM A 795, Schedule 40, seamless, black steel pipe, plain ends.

3. Steel Pipe: ASTM A 795, Schedule 10, seamless, blade steel pipe, plain ends.

D. Fittings:

1. Cast Iron Threaded Fittings: ANSI B 16.4, Class 250, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

2. Malleable Iron Threaded Fittings: ANSI B16.3, Class 300, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

3. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.

4. Grooved Mechanical Fittings for Steel Pipe: ASTM A 536, Grade 65-45-12 ductile iron . or ASTM A 53, type F or Types E or S, Grade B fabricated steel fittings with grooves or shoulders designed to accept Victaulic grooved end couplings.

5. Grooved Mechanical Couplings for Steel Pipe: Consist of ductile iron housings, a synthetic rubber gasket of a central cavity pressure responsive design; with nuts, bolts, locking pin, locking toggle or lugs to secure roll grooved pipe and fittings. Grooved mechanical couplings including gaskets used on dry pipe systems shall be listed for dry pipe service.

a. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13. Tongue and recess rigid type couplings shall only be permitted if the contractor uses a torque wrench for installation. Required torque shall be in accordance with the manufacturer's recommendations. Contractor shall remove and replace any improperly installed joints.

1) 1-1/4" thru 4": "Installation Ready" rigid type coupling designed for direct "stab" installation onto grooved end pipe without prior disassembly of the coupling equal to Victaulic FireLock® EZ Style 009.
2) 5" and Larger: Standard rigid joint equal to Victaulic FireLock® Style 005 or Style 07 Zero-Flex®.

b. Coupling gaskets shall be listed for use as follows:

Fire Protection Service	Temperature Range	Gasket Recommendation
Water/Wet Systems	Ambient	C-Shape or EZ Style 009 design Grade EPDM, Type A

6. Grooved Joint Flange Adapters for Steel Pipe: ASTM A536 ductile iron casting, flat face, for incorporating flanged components with ANSI Class 125, 150 and 300 bolt-hole patterns to a grooved system. Victaulic Style 741, 743, or 744.

7. Wrought Copper Fittings: ANSI B16.22, streamlined pattern.

8. Grooved Mechanical Fittings for Copper Tube: UL listed, grooved end fittings shall be ASME B16.22 wrought copper with copper tubing sized grooved ends designed to accept Victaulic couplings. Flaring of tube and fitting ends to IPS dimensions is not permitted.

9. Grooved Mechanical Couplings for Copper Tube: UL listed, grooved copper couplings will consist of two ductile iron housings cast with offsetting, angle-pattern bolt pads coated with copper-colored alkyd enamel. Gasket shall be pressure-responsive, synthetic rubber of a FlushSeal® design, secured together with plated steel bolts and nuts. Victaulic Style 606.

10. Grooved Copper Flange Adapters: UL listed, ductile iron casting coated with copper-colored enamel, flat faced, for engaging into roll grooved copper tube and fittings and bolting directly to flanges with ANSI Class 125 and 150 bolt-hole patterns. Victaulic Style 641.

11. Cast Iron Threaded Flanges: ANSI B16.1, Class 250; raised ground face, bolt holes spot faced.

12. Cast Bronze Flanges: ANSI B16.24, Class 300; raised ground face, bolt holes spot faced.

E. Jointing Materials:

1. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

a. Brazing Filler Metals: AWS A5.8, Classification BAgI (silver).

b. Solder Filler Metals: ASTM B 32, 95-5, Tin Antinomy.

2. Gasket Materials: Thickness, material and type suitable for fluid or gas to be handled and design temperatures and pressures.

2.2 PIPING SPECIALTIES

A. Provide piping specialties that mate and match piping and equipment connections and are UL listed.

B. Pressure gages (3-1/2" dial) shall be 0-250 psi.

C. General Duty Valves:

1. Gate Valves, 2" and Smaller: Body and bonnet of cast bronze, 175 lb. cold water working pressure, nonshock, threaded ends, solid wedge, outside screw and yoke, rising stem, screw-in bonnet, and malleable iron handwheel. Valves shall be capable of being repacked under pressure, with valve wide open.

2. Gate Valves, 2-1/2" and Larger: Iron body; bronze mounted, 175 lb. cold water working pressure, nonshock. Valves shall have solid taper wedge; outside screw and yoke, rising stem; flanged bonnet, with body and bonnet conforming to ASTM A 126, Class B; replaceable bronze wedge facing rings; flanged ends; and a packing assembly consisting of a cast iron gland flange, brass gland, packing, bonnet and bronze bonnet bushing. Valves shall be capable of being repacked under pressure with valve wide open.

3. Grooved End Gate Valves, 2-1/2" and Larger: Ductile iron body, bronze mounted, 250 psig cold water working pressure. Resilient wedge, outside screw and yoke, brass rising stem, cast iron bonnet, fusion bonded, grooved ends, and cast iron handwheel. Victaulic FireLock® Series 771.

D. Grooved End Butterfly Valves, 2-1/2" and Larger: Ductile iron body, elastomer coated ductile iron disc, 300 psig cold water working pressure, weather-proof gear actuator with pre-wired supervisory switches. Victaulic FireLock® Series 705W.

E. Check valve. Valve shall be rated at 175 PSI working pressure with cast iron body (coated with corrosion resistant red paint), brass clapper with Buna-N "O" ring and brass seat. Valve shall have tappings as required for system piping. Valve seat shall be replaceable without removing the check valve from the line.

F. Grooved End Check Valves, 2-1/2" and Larger: Ductile iron body, aluminum bronze or elastomer coated ductile iron disc, stainless steel spring and shaft, PPS coated or welded-in nickel seat. Victaulic FireLock® Series 717 or 717R with riser check kit.

G. Provide control supply gate valve at inlet of check valve with tappings as required for system piping.

H. Fire department connection valve shall be iron swing check, 175 psi rated.

I. Water flow indicators shall be vane type flow detectors. Interlock wiring to fire alarm system by Electrical Contractor.

J. Provide supervisory switches as required.

K. Flexible stainless steel hose assemblies equal to FlexHead Commercial Sprinkler Connector or AquaFlex. For use to connect sprinkler heads to the branch lines. Assembly shall include stainless steel braided hose with factory attached threaded end connections and matching ceiling attachment. Assembly shall be UL and Factory Mutual approved for installation in proposed system.

L. Flexible Drop System: In lieu of rigid pipe offsets or return bends for sprinkler drops, the Victaulic FireLock® Flexible Drop system may be used to locate sprinklers as required by final finished ceiling tiles and walls. The drop system shall consist of a braided or corrugated type 304/316 stainless steel hose piece, 1" NPT male threaded adapter for connection to header piping and a 1/2" or 3/4" NPT female adapter for connection to the sprinkler head. Unions shall be provided on either end of the flexible hose for ease of installation. The flexible drop shall attach to the ceiling grid using a one-piece bracket that can be installed without the use of tools and have a 3" minimum bending radius for installation in narrow or confined spaces. The braided drop system is UL listed and FM approved and the corrugated system is UL listed for sprinkler services to 175 psi.

M. Automatic Sprinklers:

1. Office Areas: Chrome plated, fully concealed, flush pendant equal to Victaulic Model V38.

2. Equipment and Storage Rooms (Unfinished Areas): Upright with cast brass finish equal to Victaulic Model V27.

3. Provide 165°F fusible links or 155°F frangible glass bulb, except in boiler rooms, which shall be 175°. Provide 10 spares of each type and rating along with three wrenches for each type of head. Locate sprinkler heads as shown on plan. Relocation shall be at contractor's cost.

N. Provide wall mounted post-indicating valve with supervisory switch, interlocked with annunciator panel and remote readout. Reference Section 22 05 23.

O. Provide Victaulic Style 720 TestMaster™ inspectors test and drain lines for each floor.

P. Provide siamese connection, as detailed on the drawing. Install a 90 degree elbow with drain connection at each Siamese connection for complete system drainage. Elbow shall be Victaulic #10-DR.

Q. Provide remote readout for supervision of the post indicator valve, as detailed on drawing.

R. Alarm Check Valve: 175 psig working pressure, designed for horizontal or vertical installations and have cast iron, flanged inlet and outlet, bronze grooved seat with "O" ring seals, single hinge pin and latch design. Provide trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, drip cup assembly piped without valves separate from main drain line and fill line attachement with strainer.

S. Grooved End Alarm check Valve: UL listed and FMG approved, 225 psig working pressure, designed for horizontal or vertical installations and have ductile iron grooved inlet and outlet or flanged inlet and grooved outlet, brass seat with nitrile seat "O" ring seals, single hinge pin and latch design. Provide valve trim with water bypass line with an in-line check valve, all required pipe, fittings, accessories, and gauges. All internal parts shall be replaceable without having to remove the valve from the installed position. Victaulic FireLock® Series 751.

T. Grooved End Dry-Pipe Valves: UL listed and FMG approved, low differential type, latched clapper design, 300 psig working pressure with ductile iron grooved inlet and outlet for vertical installation, brass seat with Nitrile seat "O" rings, aluminum bronze clapper, EPDM diaphragm and seal. Valve internal parts shall be replaceable without removing the valve from the installed position and be externally resettable. Valve shall be pre-trimmed as a Vic®-Quick Riser with Series 728 or 705W shutoff valve and Series 776 low pressure actuator. Minimum required air pressure is 13 psi and maximum 300 psi water pressure rating. Victaulic FireLock® NXT Series 768.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide sprinkler density and pipe sizing for light hazard occupancy except for equipment, storage rooms, which shall be ordinary hazard, Group II classification.

B. Install piping and products in accordance with manufacturer's written instructions and requirements of applicable ANSI/NFPA regulations. Coordinate installation with work of other trades.

C. Grooved joint piping systems shall be installed in accordance with the manufacturer's (Victaulic) guidelines and recommendations. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by Victaulic. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove. A Victaulic factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

D. Install sprinkler heads in center of ceiling tile. Offset run outs to each head as required using flexible assemblies or rigid piping and fittings.

E. The sprinkler bulb protector must remain in place until the sprinkler is completely installed and before the system is placed in service. Remove bulb protectors carefully by hand after installation. Do not use any tools to remove bulb protectors. Do not install sprinkler heads that have been dropped, damaged, or show a visible loss of fluid. Never install sprinklers with cracked bulbs.

F. Install drain piping at low points of system.

G. Mount supervisory switches on each sectional valve.

H. Install air vents at high points of system.

I. Alarm wiring and manual shutoff at each audible alarm station will be provided by the Electrical Contractor.

3.2 CLEAN AND TEST

A. Before piping is placed in service, flush entire system to remove foreign particles as specified in ANSI/NFPA 13. Continue flushing until water is clear and check to ensure debris has not clogged sprinklers.

B. After flushing system, test piping hydrostatically at 200 psi or 50 psi in excess of

maximum static pressure when static pressure is over 200 psi. Test for a period of 2 hours. Check for leakage. Repair or replace as required to eliminate any leakage and retest. Drain.

END SECTION 21 05 10

DIVISION 22 – PLUMBING
SECTION 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Division 31 30 00 – Earthwork, for excavation and backfill requirements.

C. Refer to Section 07 84 00 - Fire stopping, for sealing requirements at penetrations of fire rated surfaces.

1.2 CUTTING AND PATCHING

A. Hole cutting is to be held to a minimum. Furnish and set sleeves as construction proceeds. If the Contractor neglects to set sleeves, he retains responsibility for cutting required openings and shall cut same as directed by the Architect. No hole shall be cut for sleeves without the consent of the General Contractor. Work will be done under the supervision of the General Contractor.
NOTE: Field cutting of structural steel beams and purlins will not be permitted for alternative routing of piping and ductwork. If alternative openings or additional openings are required, structural fabricator shall be notified prior to steel fabrication and cost of modification shall be the responsibility of this contractor.

B. All patching incidental to the installation of this work shall be included where this Contractor has cut the opening. Patching will be by the General Contractor, reimbursed by the Contractor responsible for the cutting.

1.3 CODES AND PERMITS

A. Perform all work in strict accordance with the requirements of the State of Wisconsin Plumbing Code. Requirements outlined therein shall be minimum as related to this work.

B. Arrange for Code required inspections and pay for same if not covered by permit costs.

C. Arrange and pay for required meter deposits and utility extension costs.

1.4 DESCRIPTION OF WORK

A. Provide all labor, materials, equipment, tools and services for complete and fully operational systems of plumbing and sewering as indicated or reasonably implied by drawings and specifications. If an item is shown or specified, it shall be considered sufficient for inclusion as part of this contract work.

B. Contractor shall verify all job conditions at the site and report any discrepancies to the Engineer immediately.

1.5 WORK PRIORITY AND COORDINATION

A. Contractor, his mechanics and subcontractors shall cooperate with all others so

construction may proceed without hindrances and in all cases to the best interests of the Owner. Confer with others regarding any work that may affect this work and arrange piping, etc. in proper relation to that of others. Coordinate, prior to installation, the arrangement of plumbing work as related to heating and ventilating, electrical work, structural, fire protection and general construction.

1.6 DRAWINGS

A. Consult the drawings for the general location of all equipment, piping, and apparatus. While the sizes and locations have been indicated, the Contractor shall properly adjust his work to meet conditions as they actually exist on the premises. Equipment and piping arrangements shall provide adequate and acceptable clearance for entry, servicing and maintenance. Minor adjustments shall be discussed in the field with the Engineer with the view to convenience of operation and noninterference with other work. The Engineer reserves the right to change the location of any pipe, duct or piece of equipment to suit conditions, with no added cost to the Owner if the requested change does not modify the scope of work. Should the particular equipment which any contractor proposes to install require other space conditions than those indicated on the drawings, the Contractor shall arrange for such space with the Architect along with the shop drawing submittal. Required changes shall be noted on the submittal cover sheet. Should changes become necessary because of failure to comply with these details, the Contractor shall make such changes at his expense.

1.7 SUBMITTALS

A. Furnish shop drawings on items as indicated in individual sections including insulation, valves, plumbing fixtures, other equipment. Submit at least 6 copies for review. The contractor acknowledges its responsibility to submit complete shop drawings and other required submittals. Incomplete submittals will be returned to the contractor unreviewed. No time extensions or cost increases will be allowed for delays caused by return of incomplete submittals. Shop drawings for equipment which are noted as being reviewed by Architect or his Engineer shall not supersede Contract Documents or relieve Contractor from responsibility for deviations from the Contract Documents.

B. Furnish 3 sets of standard operating instructions and complete repair parts lists for the Owner for items of equipment and controls. Also include a summary of maintenance procedures required monthly, yearly, etc. for all equipment. Submit in binders to Engineer for approval.

1.8 REMODELING WORK

A. Wherever remodeling work or demolition of existing equipment, ductwork, piping, etc. is a part of plans and specifications, Contractor shall visit the site and thoroughly examine all existing conditions. Provide all required work necessary for interconnection of existing services with new system and removal of existing unused components. Coordinate and schedule all system shut-downs with occupant prior to beginning work.

B. Contractors shall notify the Architect at least 10 days prior to the bid closing date of any deviations or required changes that are noticed. No allowance for additional costs for work related to existing conditions will be permitted after bidding unless proof of hidden work, breakage or damage could not be determined by inspection or examination by the Contractor.

1.9 HOUSEKEEPING

A. This Contractor shall periodically remove debris caused by his operations. On completion he shall remove all debris from his work and leave same neat and clean, ready for use by the Owner.

1.10 PROTECTION OF MATERIALS AND EQUIPMENT

A. Materials and equipment shall be protected at all times. This Contractor shall be responsible for all damage caused directly or indirectly by his employees. Pipe openings shall be closed with caps or plugs during installation. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury. At the completion of all work, the equipment shall be thoroughly cleaned and delivered to the Owner in a condition satisfactory to the Engineer.

1.11 PAINTING

A. All equipment shall have manufacturer's standard baked enamel finish and shall not be job painted "unless otherwise specified". Equipment in finished rooms shall have color selected by Engineer from manufacturer's standard colors. All required touch up painting of prefinished surfaces by this Contractor.

1.12 MECHANICAL IDENTIFICATION

A. Every piece of equipment, starters, disconnect, etc. shall be stenciled with identifying number and area or rooms served, neatly printed and applied on or near item as approved by Engineer. Motors and equipment nameplates and applicable UL labels shall be in place, free from dirt, grease or paint when Project is turned over to Owner.

B. Label all accessible piping with stenciled identifying letters (1-1/2" minimum height) and direction of flow arrows at intervals of not more than 50' and at points where piping passes through walls, floors or roofs on both sides of partition.

C. Provide 1-1/4" diameter brass valve tag with stamp engraved piping system abbreviation and sequenced valve number. Attach to valve with brass chain. Provide framed and glazed valve schedule stating valve number, service and location. Mount on wall in mechanical room. Furnish additional copies in operating instruction manuals. Exclude hose bibbs and plumbing fixture faucets and stops.

1.13 INSTRUCTIONS

A. The Contractor shall review with the Owner's representative complete operating and maintenance procedures for equipment and systems installed under this contract. Provide 1 days of instructions during normal working hours when systems are fully operational and before final payment.

PART 2 - PRODUCTS

2.1 QUALITY REQUIREMENTS

A. Items indicated on the drawings and in the specifications are listed by manufacturer in order to describe minimum quality requirements.

B. Materials and equipment shall conform to requirements of Wisconsin Administrative Code.

C. All materials and equipment furnished shall be new and shall be the standard products of manufacturers regularly engaged in the production of Plumbing and Fire Protection materials and equipment.

2.2 ACCESS PANELS AND CHASES

A. Wherever valves, air vents, controllers, shock absorbers or similar pieces of operating equipment are concealed in building construction, access panels are required. This Contractor shall furnish Milcor, Miami-Carey or Bilco access panels of proper style to match adjacent finish and of approved size. Access panels shall be installed by the General Contractor in location approved by the Architect. Use stainless steel access panels except where specifically noted otherwise. Floor mounted access panels shall have a recessed surface to receive tile or finish floor. Bilco type T or equal. No obstructions allowed between panel and item to be served.

2.3 PAINTING

B. Provide painting products as indicated in Division-9 Specifications.

PART 3 - EXECUTION

3.1 ACCESS PANELS AND CHASES

A. General Contractor to provide access panels and chases where indicated. All other access panels and chases to be furnished by related Contractor in sufficient time to be built into construction by General Contractor as the work proceeds.

B. Comply with manufacturer's instructions for installation of access doors. Set frames accurately in position and securely attach to supports with face panels plumb or level. Adjust hardware and panels after installation for proper operation.

3.2 PAINTING

A. Refer to Division 9 for paint application specification. All field painting of exposed mechanical shall be work under Division 9.

B. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate, for type of material being applied, and for ambient conditions. Apply additional coats when undercoats, stains or other conditions show through the final coat.

C. Paint all exterior piping, exterior ductwork, interior rustable ferrous piping in exposed unfinished areas, and interior mechanical materials and equipment exposed in unfinished areas not already factory finish painted to match adjacent construction.

D. Mechanical equipment in all finished areas is to be painted by General Contractor.

END SECTION 22 05 00

DIVISION 2 - PLUMBING
SECTION 22 05 23 – GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Provide factory fabricated valves recommended by manufacturer for use in service indicated.

B. Provide valves of sizes, types and pressure ratings indicated with connections that properly mate with pipe, tube and equipment connections.

C. Provide valves at all locations shown on drawings or noted as follows. Provide drain valves at all low points and where required for draining. Provide valves at all automatic control valve locations. Provide valves in all branch take-offs from main supply risers and where necessary to isolate pipe runs. Provide valves on all supply lines to equipment.

D. Butterfly valves (3" and larger) or ball valves (2-1/2" and smaller) may be substituted for gate and globe valves at Contractor's option.

1.3 SUBMITTALS

A. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for each type of valve. Include pressure drop curve or chart for each size and type of valve.

B. Maintenance Data: Submit maintenance data and spare parts lists for each type of valve. Include this in maintenance manual.

1.4 QUALITY ASSURANCE

A. Marking of valves shall comply with MSS SP-25.

B. Domestic water valve stems shall be ASTM B 371-694 alloy A rod (7% zinc maximum).

C. For valves on fire protection piping, provide listing by UL and Associated Factory Mutual Fire Insurance Companies.

PART 2 - PRODUCTS

2.1 GATE VALVES

A. Packing: Valves shall be designed for repacking under pressure when fully opened and equipped with packing suitable for service. Valve back seating shall protect packing and stem threads from fluid when valve is fully opened. Valve shall be equipped with gland follower.

B. Standards: Cast Iron Valves - MSS SP-70
Bronze Valves - MSS SP-80
Steel Valves - ANSI B16.34

C. Domestic Water Service: Flanged ends 2-1/2" and larger shall be Class 125, iron body bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge. (Jenkins #651-A or Milwaukee F-2885)

D. Fire Protection Service:

1. Threaded ends 2" and smaller shall be Class 175, bronze body, butterfly valve with built-in supervisory switch. (Milwaukee #BB-SCS02)

2. Flanged ends 2-1/2" and larger shall be Class 175, iron body, bolted bonnet, rising stem, OS&Y, solid wedge. (Jenkins #825A)

2.2 GLOBE VALVES

A. Packing: Valves shall be designed for repacking under pressure when fully opened and equipped with packing suitable for service. Valve back seating shall protect packing and stem threads from fluid when valve is fully opened. Valve shall be equipped with gland follower.

B. Composition Discs: Material shall be suitable for intended service. Fit composition disc valve with throttling nut for stem throttling service. Provide hardened stainless steel disc and seat ring for metal seated globe valves.

C. Standards: Cast Iron Valves - MSS SP-85
Bronze Valves - MSS SP-80
Steel Valves - ANSI B16.34

D. Domestic Water Service: Flanged ends 2-1/2" and larger shall be Class 125, iron body, bolted bonnet, rising stem, (S&Y, renewable seat and disc. (Jenkins #613 or Milwaukee #F2981)

E. Manufacturer: Subject to compliance with the above, one of the following: Crane; Fairbanks; Grinnell; Hammond; Jenkins; Milwaukee; Nibco Scott; Powell; Stockham; or approved equal.

2.3 DRAIN VALVES

A. Low Pressure Drainage Service: Threaded ends 1-1/2" and smaller shall be Class 125, bronze body, screwed bonnet, nonrising stem, solid wedge. Jenkins #372, Watts B-6000-CC, Watts B-6001-cc, or approved equal.

B. Manufacturer: Subject to compliance with the above, one of the following: Crane; Fairbanks; Grinnell; Hammond; Jenkins; Milwaukee; Nibco Scott; Powell; Stockham; Walworth; or approved equal.

2.4 BALL VALVES

A. Valve shall have port area equal to or greater than connecting pipe area and shall include seat ring designed to hold sealing material.

B. Standards: Cast Iron Valves - MSS SP-72

Steel Valves - ANSI B16.34

C. Domestic Water Service:

1. Threaded ends 2" and smaller shall be Class 125, bronze 2 piece body, bronze ball, bronze stem, and full port.

2. Soldered ends 3" and smaller shall be Class 125, bronze 2 or 3 piece body, chrome plated bronze ball, bronze stem, and full port.

D. Manufacturer: Subject to compliance with the above, one of the following: Apollo 77-200; Crane; Fairbanks; Grinnell; Hammond 8511; Jamesbury; Jenkins; Milwaukee BA400; Nibco Scott S580-70; Powell; Stockham; Walworth; Watts ; Whitey; or approved equal.

2.5 BUTTERFLY VALVES

A. Butterfly valves used as shutoffs for equipment or terminal removal shall be lug type. Valves for other applications shall be wafer-type. Provide ratchet handles on valves 6" and smaller and gear operators on valves 8" and larger. Comply with MSS SP-67.

B. Domestic Water Service:

1. Threaded ends 2" and smaller shall be Class 150, bronze body, full port, stainless steel trim, Viton seal. (Milwaukee #BB2-100)

2. Soldered ends 2" and smaller shall be Class 150, bronze body, full port, stainless steel trim, Viton seal. (Milwaukee #BB2-350)

3. Wafer type 3" and larger shall be Class 150, cast-iron body, lever operated, chromium plated ductile iron disc, Type 410 stainless steel stem, EPDM seat. (Jenkins #200-series) (Jenkins # 225-series for high pressure)

4. Lug type 2.5" and larger shall be Class 150, cast iron or ductile iron body, lever operated, chromium plated ductile iron or S.S. disc, Type 416 stainless steel stem, EPDM seat. (Jenkins-series) (Jenkins # 225-series for high pressure)

C. Manufacturer: Subject to compliance with the above, one of the following: Apollo,Crane; DeZurik; Fairbanks; Grinnell; Hammond; Jenkins; Milwaukee; Nibco; Powell; Stockham; Victualic; Watts; or approved equal.

2.6 SWING CHECK VALVES

A. Unless a composition disc is specified, valves 1.5" and smaller shall be bronze, regrinding, with seating angle 40-45°. Provide stop plug as a renewable stop for disc hanger, unless otherwise specified. Disc and hanger shall be separate parts, and the disc free to rotate. Hanger pins shall be supported on both ends by removable side plugs.

B. Standards: Bronze Valves to 150 psi - ANSI/ASTM B 62

Metallic Seated Bronze Valves to 300 psi	- ANSI/ASTM B 61
Iron Body Valves	- ANSI/ASTM A 126, Grade B
All Valves	- MSS SP-71

C. Domestic Water Service:

1. Threaded ends 1.5" and smaller shall be Class 125, bronze body, screwed cap,

horizontal swing, bronze disc. Crane 1342, Hammond IB941, Nibco S413B, Watts CVYS, Jomar, Apollo, Milwaukee, or approved equal.

2. Soldered ends 2" and smaller shall be Class 125, bronze body, screwed cap, horizontal swing, bronze disc. (Jenkins #1222)

3. Flanged ends 2" and larger shall be Class 125, iron body bronze mounted, bronze trim, bolted cap, horizontal swing, non asbestos gasket, renewable bronze disc. Crane 383, Milwaukee F2974, Nibco F918B, or approved equal.

D. Fire Protection Service: Flanged ends 2-1/2" and larger shall be Class 175, iron body bronze mounted, bolted cap, horizontal swing, bronze disc. (Jenkins #729)

E. Manufacturer: Subject to compliance with the above, one of the following: Crane; Jenkins; Nibco Scott; Powell; Stockham; Walworth; Milwaukee; Hammond; Watts; Jomar; Apollo; or approved equal.

2.7 WAFER CHECK VALVES

A. Provide wafer style, butterfly type spring actuated check valves that are designed to be installed with gaskets between standard Class 125 flanges.

B. Standards: Iron Valves - ANSI/ASTM A-126, Grade B

C. Water Service: 2.5" and larger shall be Class 125, cast iron body, bronze or stainless steel trim, bronze disc, bronze or EPDM seat. (Nibco Scott W-910)

D. Fire Protection Service: 4" and larger shall be Class 250, cast iron body, stainless steel trim, S.S. spring and stem, cast iron disc, Buna-N seal. (Nibco Scott #W-900-W).

E. Manufacturer: Subject to compliance with the above, one of the following: APCO 300/600; Bell and Gossett; Centerline CLC with full body options; Hammond IR9354; Milwaukee 1800; Jenkins; Nibco Scott; Stockham; Val-Matic 1400/1800/8000; Vitaulic; or approved equal.

2.8 LIFT CHECK VALVES

A. Valves 2" and smaller shall be bronze (or forged steel for HP steam).

B. Valves 2.5" and larger shall be cast or ductile iron, wafer or globe type.

C. Standards: Bronze Valves - ANSI/ASTM B 62
All Valves - ANSI/FCI 74-1

D. Horizontal lift check valves shall be straight pattern, threaded ends, rated for 150 psi saturated steam, renewable composition disc, screw-over cap, bronze body. (Jenkins #117-A)

E. Vertical lift check valves shall be straight pattern, threaded ends, rated for 150 psi saturated steam, renewable composition disc, screw-in hub, bronze body. (Jenkins #119)

F. Air compressor lift check valves shall be straight pattern, threaded ends, rated for 300 psi air, flat stainless steel disc, renewable bronze seat ring, stainless steel spring, screw-in cap, bronze body. (Jenkins #54)

G. Spring loaded horizontal lift check valves shall be straight pattern, threaded ends, rated

for 150 psi saturated steam, renewable composition disc, phosphor bronze spring, screw-over cap, bronze body. (Jenkins #655-A)

NOTE: Spring lift check valves shall be provided at all pump discharges.

H. Manufacturer: Subject to compliance with the above, one of the following:

1.) 2" and smaller, ConBraCo , Mueller 203BP, Nibco S480Y, and Val-Matic S1400.
2.) 2.5" and larger APCO 300, Centerline, Hammond, Milwaukee 1800, Mueller 101 AP, Nibco W910 or F910, Val-Matic 1400/1800/8000.

2.9 BACK-WATER VALVES:

A. Cast iron offset type body with bronze swing check assembly and bolted cover. Provide access to the check assembly. (Josam #67500 or 67610).

B. Manufacturer: Subject to compliance with the above, one of the following: Josam; Zurn; Wade, or approved equal.

2.10 PRESSURE REDUCING VALVES:

A. Bronze body, diaphram operated, with an integral thermal expansion bypass, inlet union, stainless steel strainer, renewable monel or stainless steel seat and adjustable reduced pressure range, 300 plig at 160°F. Preset for the scheduled water pressure (80 psig for domestic water service).

B. Manufacturer: Subject to compliance with the above, one of the following: Conbraco; Watts; Wilkins or approved equal.

2.11 BACKFLOW PREVENTERS

A. BP-2: ASSE 1035, brass, bronze or stainless steel body construction, EPDM diaphragm and seat, stainless steel internals, rated for 150 psig and 140°F. Equal to Watts NLF9.

2.12 REDUCED-PRESSURE BACKFLOW PREVENTERS (RPBP):

A. BP-1 ASSE 1013" reduced pressure principle backflow assembly complete with inlet strainer, inlet and outlet ball or butterfly isolation valves. Sized for maximum pressure drop of 10 psig at 2 gpm. Construct of bronze or epoxy coated cast iron body with bronze and plastic internal parts, stainless steel springs, non-threaded vent outlet, 4 test cocks, rated for 175 psig and 210°F, with air gap apparatus on drain. Equal to Watts series 919-S-QTS.

B. Manufacturer: Subject to compliance with the above, one of the following: Watts or approved equal.

2.13 BALANCE VALVES

A. 2" and smaller: Bronze body with calibrated brass orifice, integral pointer and calibrated scale to register degree of valve opening, memory stop, drain tapping, threaded ends, with or without integral unions, pressure taps with integral check valves and seals, adjustable memory stop, suitable for 125 psig water working pressure at 240EF.

B. Manufacturer: Subject to compliance with the above, one of the following: Armstrong

CBV; Bell & Gossett Circuit Setter Plus; Flowset AccuSetter; Illinois 6000 series; Taco Circuit Setter; Watts B-6000/B-6001; BS Apollo; Grinnel; Hammond; Jomar; Milwaukee; Nibco; or approved equal.

C. Include one bellows type differential pressure meter kit that includes a six inch diameter gauge with 270□ arc readout and having an accuracy of ±1% of full scale or better and suitable for the differential pressures of the valves supplied for this project, over-range protection, color coded hoses not less than ten feet in length with brass connectors suitable for connection to the low and high pressure connections on the balance valves, instrument valving so meter can be vented and drained, pressure and temperature rating at least equal to that of the valves. Provide meter and all accessories in a durable case with carrying handle.

D. Manufacturer: Subject to compliance with the above, one of the following: Barton 247A; Midwest 809; or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves according to manufacturer's recommendations. Locate valves so as to be accessible for operating and servicing with access panels provided where required. Install valves with stems horizontal or above. Provide dielectric unions only on plumbing piping between valves and piping when dissimilar metals are to be joined.

B. Install mechanical actuators where indicated, and where valves 4" and larger are mounted more than 7' above floor in the mechanical and boiler rooms. Actuator shall extend down to 7' above floor.

C. Extend relief discharge from pressure reducing and RPBP valves to local drain. Install RPBP at wall at code height and with required clearances for service and inspection.

END SECTION 22 05 23

DIVISION 22 - PLUMBING AND SEWERING
SECTION 22 05 29 - SUPPORTS, ANCHORS AND SEALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of supports, anchors and seals required by this section is indicated on drawings and/or specified in other Division 22 sections.

B. Supports, anchors and seals furnished as part of factory fabricated equipment are specified as part of the equipment assembly in other Division 22 sections.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacturer of supports, anchors and seals of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Code Compliance: Comply with applicable plumbing codes pertaining to product materials and installation of supports, anchors and seals.

C. UL and FM Compliance: Provide products which are Underwriters Laboratories listed and Factory Mutual approved.

D. MSS Standard Compliance:

1. Provide pipe hangers and supports of which materials, design and manufacture comply with ANSI/MSS SP-58 and the latest requirements of ANSI code.

2. Select and apply pipe hangers and supports, complying with MSS SP-69 & SP-58.

PART 2 - PRODUCTS

2.1 MANUFACTURERS OF HANGERS AND SUPPORTS

A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following: F & S Central Manufacturing; Fee & Mason Manufacturing; ITT Grinnell; or approved equal.

2.2 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory fabricated horizontal piping hangers and supports complying with ANSI/MSS SP-58 of one of the following types listed, selected by Installer to suit horizontal piping systems in accordance with manufacturer's published product information. Use only one type by one manufacturer

for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper plated hangers and supports for copper piping systems. Provide the following or approved equal.

B. Adjustable Steel Clevises: (2-1/2" - 30") Grinnell Fig. 260, B line B3100, or Anvil 260.

C. Alloy Steel Pipe Clamps: (high temp 4" to 20") Grinnell F224 and 246. B-Line type S with B-2000 Series clamps, Anvil type PS 200H with PS 1200 clamps. Use B-line B1999 Vibra Cushion for insulated copper piping or manufacturers clamp and cushion assembly.

D. Steel Pipe Clamps: (1/2" - 12" w/no insulation) Grinnell Fig. 212 and 216. B-Line type S with B-2000 Series clamps, Anvil type PS 200H with PS 1200 clamps. Use B-line B1999 Vibra Cushion for insulated copper piping or manufacturers clamp and cushion assembly.

E. Adjustable Steel Band Hangers: (1/2" - 2" noninsulated) Grinnell Fig. 269.

F. Split Pipe Rings: (3/8" - 2" noninsulated) Grinnell Fig. 108.

G. U-Bolt: Grinnell 137 and 137C.

H. Clips: Grinnell 263.

I. Pipe Slides and Slide Plates: Grinnell 257, Type 2 and 3.

J. Pipe Stanchion Saddles: Grinnell 259, including steel pipe base support and cast iron floor flange.

K. Single Pipe Rolls: Grinnell 171.

L. Adjustable Roller Hangers: Grinnell 181.

M. Pipe Roll Stands: Grinnell 271.

N. Pipe Rolls and Plates: Grinnell 277.

2.3 VERTICAL PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory fabricated vertical piping clamps complying with ANSI/MSS SP-58 of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper plated clamps for copper piping systems.

B. Two Bolt Riser Clamps: Grinnell Fig. 261 and 261C.

2.4 HANGER ROD ATTACHMENTS

A. General: Except as otherwise indicated, provide factory fabricated hanger rod attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal piping hangers and building attachments in accordance with manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger rod attachments to suit hanger rods. Provide copper plated hanger rod attachments for copper piping systems.

B. Steel Turnbuckles: Grinnell 230.

C. Swivel Turnbuckles: Grinnell 114.

2.5 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory fabricated building attachments complying with ANSI/MSS SP-58 and MSS SP-69 of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper plated building attachments for copper piping systems.

B. Concrete Inserts: Grinnell Fig. 282 and 279 (#117 where permitted).

C. Side Beam or Channel Clamps: Grinnell Fig. 226 and 266 and 265.

D. Center Beam Clamps: Grinnell Fig. 131.

E. Welded Attachments: Grinnell Fig. 66.

F. C Clamps: Grinnell Fig. 86 and 87.

G. Malleable Beam Clamps: Grinnell Fig. 229. Malleable black iron B-Line B3036L/B3034, Anvil 86/92, or approved equal.

H. Forged Steel Jaw type clamp: MSS SP-69 Type 28 or Type 29, B-Line B3054, Anvil 228 or approved equal.

I. Steel Brackets: One of the following for indicated loading:

Light Duty:	(750#)	Grinnell 194
Medium Duty:	(1500#)	Grinnell 195
Heavy Duty:	(3000#)	Grinnell 199

2.6 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory fabricated for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Saddles: Grinnell 160-166A; fill interior voids with segments of insulation matching adjoining insulation.

C. Protection Shields: Grinnell 167; of length recommended by manufacturer to prevent crushing of insulation.

2.7 SPRING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory fabricated spring hangers and supports complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select spring hangers and supports to suit pipe size and loading.

B. Spring Cushion Hangers: Fee and Mason 404.

C. Spring Cushion Roll Hangers: Grinnell 178.

2.8 MISCELLANEOUS MATERIALS

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ANSI/ASTM A36.

C. Cement Grout: Portland Cement (ANSI/ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ANSI/ASTM C404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand by volume with a minimum amount of water required for placement and hydration.

D. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards. Provide steel channels with welded spacers and hanger rods.

E. Pipe Guides: Provide factory fabricated guides of cast semisteel or heavy fabricated steel consisting of a bolted two section outer cylinder and base with a two section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any) and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed.

B. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments. Attachments to structural steel shall be completed prior to installation of structural fireproofing.

3.2 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete or on structural steel prior to installation of structural fireproofing for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69.

B. Install additional building attachments where support is required for additional concentrated loads including valves, flanges, guides, strainers, expansion joints and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping and do not support piping from other piping. Support spacing shall be based on midspan deflection of 0.5" maximum and allowable bending stress of 10,000 psi.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Equipment room piping over 3-1/2" shall be supported by spring cushion hangers.

D. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated or by other recognized industry methods.

E. Provisions for Movement: Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

F. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.

H. Insulated Piping: Comply with the following installation requirements:

1. Clamps: Attach clamps to hot water and steam piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.

2. Shields: Where low compressive strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. For pipe 8" and over install wood insulation saddles.

3. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

I. Support fire protection water piping independently of other piping supports.

3.4 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31 and to prevent transfer of loading and stresses to connected equipment. Use welding steel shapes, plates, and bars to secure piping to the structure.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure prior to installation of structure fireproofing. Comply with ANSI B31 and with AWS standards.

C. Where expansion compensators are indicated install anchors in accordance with expansion unit manufacturer's written instructions to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

ADJUSTMENT OF HANGERS AND SUPPORTS

E. Adjust hangers and supports and place grout as required under supports to bring piping to proper levels and elevations.

END SECTION 22 05 29

DIVISION 22 – PLUMBING
SECTION 22 07 00 – PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

A. ANSI/ASTM C533 – Calcium Silicate Block and Pipe Thermal Insulation

B. ANSI/ASTM C534 – Elastomeric Foam Insulation.

C. ASTM C591 – Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation

D. ASTM E84 – Surface Burning Characteristics of Building Materials.

E. NFPA 255 – Surface Burning Characteristics of Building Materials.

F. UL 723 – Surface Burning Characteristics of Building Materials.

1.3 DESCRIPTION OF WORK

A. Provide thermal insulation for piping and equipment as specified herein.

B. Insulation thicknesses required for the various system types are as scheduled on plans, as required by the Wisconsin Administrative Code, and as specified herein. In case of conflict, the more rigid requirement shall apply. All insulation thicknesses listed are based on a minimum thermal efficiency (R-Value) with the intent to provide a minimum thermal efficiency. Install insulation in accordance with latest MICA standards and manufacturer instructions.

C. Insulate portions of existing piping and equipment where existing insulation was removed by Owner's abatement contractor, for new connections to existing systems by Division 22 contractor.

1.4 SUBMITTALS

A. Certifications: Submit certifications or other data as necessary to show compliance with these specifications and governing regulations.

B. Submit a schedule indicating Service (HW, CW, Equipment, etc.), Insulation type, and Insulation Thickness.

1.5 QUALITY ASSURANCE

A. Installer shall be firm trained and regularly engaged in the application of mechanical insulations. Installer shall be responsible for all debris, rubbish and damages to building parts caused by his operation.

B. Materials: Flame Spread/Smoke developed rating of 25/50 in accordance with ASTM E84,NFPA 255, or UL 723 (where required)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following: Armstrong; Certainteed; Gustin Bacon; Knauf; Manville Co.; Owens-Corning; United States Gypsum; or approved equals.

2.2 FLAME SPREAD/SMOKE DEVELOPED RATING

A. Insulation systems shall have a flame spread/smoke developed rating of 25/50 or less.

2.3 FIBERGLASS PIPE INSULATION

A. Fiberglass pipe insulation shall be rigid heavy density insulation with "K" factor of .23 at 75°F and factory applied fire retardant vapor barrier jacket of white kraft bonded to aluminum foil with fiberglass reinforcing. Manville Microlok 650 or equal.

B. Fiberglass Pipe Fitting Insulation:

1. Hot water pipe fittings and valves shall be insulated with premolded fiberglass fittings or mineral wool cement with 1/4" coat of hydraulic setting finishing cement to a thickness equal to adjacent pipe insulation. Vapor seal fittings with fiberglass tape and completely seal with Benjamin Foster 30-35. Preformed PVC jackets may be used.

2. All other pipe fittings and valves may be insulated with fiberglass miter segments of equal thickness of adjoining insulation with 1/4" coat of hydraulic setting finishing cement. Vapor seal fittings with fiberglass tape and completely seal with Benjamin Foster 30-35.

3. ANSI/ASTM C547, .24 maximum "K" value at 75° F non-combustible. All purpose, white kraft jacket bonded to aluminum foil and reinforced with fiberglass, 25/50 flame spread/smoke developed rating.

2.4 FLEXIBLE ELASTOMERIC PIPE INSULATION

A. Flexible elastomeric pipe insulation shall have "K" factor of .27 at 75°F ANSI/ASTM C534, flexible plastic, 25/50 flame/smoke developed rating. Armstrong Armaflex II with Armstrong 520 sealant, or equal.

B. Flexible elastomeric pipe insulation fittings shall be fabricated from miter cut piping insulation or sheet insulation.

2.5 POLYOLEFIN INSULATION:

A. Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal conductivity of not more than 0.24 at 75 degrees F, minimum compressive strength of 5 psi at 25% deformation, maximum water vapor transmission of 0.0 perm inch, maximum water absorption of 0% by weight and volume, rated for service range of -165 degrees F to 210 degrees F.

2.6 EXTRUDED POLYSTYRENE INSULATION:

A. Rigid closed cell, minimum nominal density of 2.2 lbs. per cu. ft., thermal conductivity of not more than 0.2 at 75 degrees F, minimum compressive strength of 35 psi, maximum water vapor transmission of 1.1 perm inch, maximum water absorption of .1% by volume, rated for service range of -290 degrees F to 165 degrees F.

2.7 UNDER SINK/LAVATORY PIPE INSULATION

A. Provide molded closed cell vinyl insulating wrap for all exposed piping under all handicapped accessible sinks and lavatories. System shall be equal to "Handi Lav-Guard" by Truebro, Inc.

2.8 FIRE BARRIER PLENUM WRAP

A. Fire resistant flexible fiber wrap consisting of inorganic blanket encapsulated with a scrim-reinforced foil providing a non-combustible enclosure for combustible plastic pipes in return air plenums as tested to UL 910. 3M Fire Barrier Plenum Wrap 5A or equal.

2.9 ACCESSORIES

A. Bedding Compounds: Nonshrinking, permanently flexible, compatible with insulation.

B. Vapor Barrier Coating: Nonflammable, fire resistant, polymeric resin, compatible with insulation.

C. Insulating Cement: ANSI/ASTM C195, hydraulic setting mineral wool.

D. Wire Mesh: Corrosive resistant metal, hexagonal pattern.

PART 3 - EXECUTION

3.1 DOMESTIC WATER PIPING INSULATION

A. Domestic cold and hot water piping shall be insulated as scheduled. Cold piping shall be provided with vapor barrier.

3.2 STORM & WASTE PIPING INSULATION

A. All interior aboveground (horizontal & first 5' vertical) storm water and clear water waste piping and roof drains bodies shall be insulated as scheduled. Plumbing vents within 6 lineal feet of roof outlet shall be insulated as scheduled.

3.3 COMBUSTIBLE PIPE MATERIALS LOCATED IN RETURN AIR PLENUMS

A. Insulate combustible piping where located in return air plenums with fire barrier plenum wrap. Fire barrier plenum wrap replaces thermal insulation where scheduled to be ½" thick. Where thermal insulation is scheduled to be thicker than ½", the pipe material shall be non-combustible.

3.4 INSULATION INSTALLATION

A. Install insulation products in accordance with manufacturer's written instructions and in accordance with recognized industry standards to ensure that insulation serves its intended purpose. Clean and dry surfaces prior to installation. Apply when surfaces to be

insulated are at room temperature. Use adhesives, sealers, protective finishes, staples, bands, wires, studs, pins, clips, etc. as recommended by manufacturer. Staples or other fasteners that may puncture vapor barrier shall not be used on cold water piping. Maintain integrity of vapor barriers. Extend insulation without interruption through walls, floors and similar penetrations, except where otherwise indicated. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation. Do not insulate over nameplates and labels; bevel and seal around such. Fill cracks, joints, seams and depressions with bedding compound or vapor barrier cement. Provide smooth finish on all insulated surfaces.

B. Fiberglass pipe insulation shall be continuous, uninterrupted through the hanger. Hanger shall be sized for the outside diameter of the pipe insulation. Install sheet metal shield between bearing point of hanger and insulation. Provide inserts where required. All Insulation material shall be applied only when ambient temperature is between 40° F and 110° F. Adhesive and lap must be free from dirt and water. Pressurize lap seal repeatedly with sealing tool. Wrap end joints with 3" wide vapor barrier tape. Seal off ends of pipe insulation with glass cloth and vapor barrier coating.

C. Flexible elastomeric pipe insulation shall be completely sealed along seams and butt joints with full covering of adhesive on both surfaces to be joined. Insulation shall not be stretched or forced to a longer length. Paint insulation to match adjacent insulation. Exterior piping insulation shall be painted with UV protective paint.

D. Fire barrier plenum wrap system shall be installed in accordance with UL 910 and the manufacturer's instructions using appropriate size sheets, specified perimeter and longitudinal material overlaps, filament tape, minimum ½" wide steel or 16 gauge steel wire banding material.

3.5 INSULATION SCHEDULES

Piping Service	**Insulation Type ***	**Insulation Thickness by Pipe Size**				
		1" and smaller	1-1/4" to 2"	2-1/2" to 4"	5" to 6"	8" and larger
Hot Water (Sply & Rtn)	rigid fiberglass	1-1/2"	1-1/2"	2"	2"	2-1/2"
Cold Water	rigid fiberglass	1"	1"	1"	1"	1"
Horizontal Storm & first 5 ft vertical)	rigid fiberglass		1/2"	1/2"	1/2"	1/2"
Roof Drain Bodies	Flexible Elastomeric		1/2"	1/2"	1/2"	1/2"
Vents (within 6 lf of roof outlet), unless PVC	rigid fiberglass	1/2"	1/2"	1/2"	1/2"	1/2"

** Fire barrier plenum wrap replaces thermal insulation where scheduled to be ½" thick. Where the thermal insulation is scheduled to be thicker than ½", the pipe material shall be non-combustible.

SEMI-RIGID FIBERGLASS:

Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place. Fill all joints, seams and depressions with insulating cement to a smooth, even surface. Cover with reinforcing fabric and 2 coats of mastic. . Use vapor barrier mastic on systems requiring a vapor barrier.

ELASTOMERIC/POLYOLEFIN:

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

END SECTION 22 07 00

DIVISION 22 - PLUMBING
SECTION 22 10 50 - PIPE, TUBE AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.
B. Section - 22 07 00 Plumbing Insulation

1.2 DESCRIPTION OF WORK

A. Extent of pipe, tube and fittings required by this section is indicated on drawings and/or specified in other Division 22 sections.

B. Types of pipe, tube and fittings specified in this section include the following:

1. Piping Materials:
   Steel Pipe
   Copper Tube
   Cast Iron Pressure Pipe
   Cast Iron Soil Pipe
   Plastic Pipe
   Plastic Tubing
   PVC Coated Steel Pipe

2. Pipe/Tube Fittings:
   Fittings for Steel Pipe
   Fittings for Copper Tube
   Fittings for Cast Iron Pressure Pipe
   Fittings for Cast Iron Soil Pipe
   Fittings for Plastic Pipe
   Fittings for Plastic Tubing

3. Grooved Piping Products

4. Miscellaneous Piping Materials/Products

C. Pipe, tube and fittings furnished as part of factory fabricated equipment are specified as part of the equipment assembly in other Division 22 sections.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacturer of pipe, tube and fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Welding: Quality welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9 as applicable, for shop and project site welding of piping work.

Certify welding of piping work using the Standard Procedure Specifications by and welders tested under supervision of the National Certified Pipe Welding Bureau

(NCPWB).

C. Brazing: Certify brazing procedures, brazers and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job site brazing of piping work.

1.4 DELIVERY, STORAGE AND HANDLING

A. Except for concrete, hub and spigot and similar units of pipe, provide factory applied plastic end caps on each length of pipe and tube. Maintain end caps through shipping, storage and handling as required to prevent pipe end damage and eliminate dirt and moisture from inside of pipe and tube.

B. Where possible store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. General: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service.

B. Steel Pipe (4" and larger shall be seamless):

1. Black Steel Pipe: ANSI/ASTM A53.
2. Galvanized Steel Pipe: ANSI/ASTM A53.
3. Seamless Steel Pipe: ANSI/ASTM A53.
4. Galvanized Seamless Steel Pipe: ANSI/ASTM A53.
5. Electric Resistance Welded Steel Pipe: ANSI/ASTM A135.
6. Steel Water Pipe: ANSI/AWWA C200 for pipe 6" and larger.

C. Copper Tube:

1. Copper Tube: ANSI/ASTM B88;
   a. Type L for Domestic Water above grade; hard drawn temper.
   b. Type K for direct buried Domestic Water; soft copper without joints below grade.
2. DWV Copper Tube: ANSI/ASTM B306.
3. ACR Copper Tube: ANSI/ASTM B280.
   a. Type L for above grade medical gases; hard drawn temper.

D. Cast Iron Pressure Pipe:

1. Cast Iron Pressure Pipe: ANSI A21.6; ANSI/AWWA C106 and B16.4.
2. Ductile Iron Pipe: ANSI A21.5; ANSI/AWWA C151.
3. Cement Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings: ANSI A21.4; ANSI/AWWA C104.

E. Cast Iron Soil Pipe:

1. Hubless Cast Iron Soil Pipe: CISPI 301; include coupling assembly; CISPI 310.

2. Cast Iron Hub and Spigot Soil Pipe: ANSI/ASTM A74.

F. Plastic Pipe:

1. Polyvinyl Chloride Pipe (PVC): ANSI/ASTM D1785. D2466 for schedule 40.
2. Polyvinyl Chloride Sewer Pipe (PVC): ANSI/ASTM D2729. 2464 for schedule 80.
3. Polyvinyl Chloride Plastic Drain, Waste and Vent Pipe (PVC): ANSI/ASTM D2665.

G. PVC Coated Steel Pipe: Black steel (seamless) pipe, schedule 40, machine wrapped with 1/32" PVC tape with 50% overlap.

2.2 PIPE/TUBE FITTINGS

A. General: Provide factory fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, and valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections and with pipe manufacturer's recommendations where applicable.

B. Fittings for Steel Pipe:

1. General: Piping 2-1/2" and larger shall be welded and piping 2" and smaller may have screwed fittings.

2. Malleable Iron Threaded Fittings: ANSI B16.3; plain or galvanized as indicated.

3. Malleable Iron Threaded Unions: ANSI B16.39; selected by Installer for proper piping fabrication and service requirements including style, end connections and metal-to-metal seats (iron, bronze or brass); plain or galvanized as indicated.

4. Threaded Pipe Plugs: ANSI B16.14.

5. Steel Flanges/Fittings: ANSI B16.5 including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated:

   a. Material Group: Group 1.1
   b. End Connections: Butt Welding
   c. Facings: Raised face

6. Steel Pipe flanges for Waterworks Service: ANSI/AWWA C207.

7. Forged Steel Socket Welding and Threaded Fittings: ANSI B16.11 except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe. Use of welded branchlets will be allowed.

8. Wrought Steel Buttwelding Fittings: ANSI B16.9 except ANSI B16.28 for short radius elbows and returns; rated to match connected pipe.

9. Cast Iron Threaded Drainage Fittings: ANSI B16.12.

10. Forged Branch Connection Fittings: Except as otherwise indicated, provide type as determined by Installer to comply with installation requirements.

11. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than Schedule 80 pipe where length remaining unthreaded is less

than 1-1/2" and where pipe size is less than 1-1/2" and do not thread nipples full length (no close nipples).

12. PVC fittings: Welded joints and fittings shall be protected with hand wrapped PVC tape (12 mill) using 150% overlap extending 6" beyond end of machine wrap.

C. Fittings for Copper Tube:

1. Wrought Copper Solder Joint Fittings: ANSI B16.22 and ASTM B32.
2. Wrought Copper Solder Joint Drainage Fittings: ANSI B16.29
3. Cast Copper Flared Tube Fittings: ANSI B16.26.
4. Bronze Pipe Flanges/Fittings: ANSI B16.24.
5. Nonferrous Pipe Flanges: ANSI B16.31.
6. Copper Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

D. Fittings for Cast Iron and Ductile Iron Pressure Pipe:

1. Cast Iron Fittings: ANSI A21.10; ANSI/AWWA C110 and ANSI B16.4.
2. Ductile Iron Fittings: ANSI A21.10; ANSI/AWWA C110.
3. Rubber Gasket Joints: ANSI A21.11; ANSI/AWWA C111.

E. Fittings for Cast Iron Soil Pipe:

1. Hubless Cast Iron Soil Pipe Fittings: CISPI 301; and complying with governing regulations.
2. Cast Iron Hub and Spigot Soil Pipe Fittings: Match soil pipe units; complying with same standards (ANSI/ASTM A74).
3. Compression Gaskets: CISPI Standard HSN.
4. Lead/Oakum Joint Materials: Provide products complying with governing regulations for use in service indicated.

F. Fittings for Plastic Pipe:

1. PE Pipe Fittings: ASTM D2609 for insert fittings; ANSI/ASTM D3261 for Schedule 40 and 80.
2. PVC Sewer Pipe Fittings: Match PVC sewer pipe; comply with same standard (ANSI/ASTM D2729); ANSI/ASTM D2564 for solvent cement.

G. Fittings for Plastic Tubing:

1. General: Provide fittings of type indicated, matching tubing. Where not otherwise indicated, provide fittings produced and recommended for service indicated by manufacturer of tubing.

H. Grooved Piping Products:

1. General: As Installer's option, mechanical grooved pipe couplings and fittings per ASTM F1476 may be used for piping systems having operating conditions not exceeding 200°F, (excluding steam piping and any other service not recommended by manufacturer) in lieu of welded, flanged or threaded methods and may also be used as unions, seismic joints, expansion joints, expansion compensators or vibration reducers.

NOTE: Groove type shall be CUT GROOVE, except for fire protection system that may be ROLL GROOVE. Roll groove may be used, upon proof of roll

grooving tool capacity.

2. Coupling Housings: Malleable iron conforming to ANSI/ASTM A47.

3. Coupling Housings Description: Grooved mechanical type which engages grooved or shouldered pipe ends encasing an elastomeric gasket which bridges pipe ends to create seal. Cast in two or more parts, secure together during assembly with nuts and bolts. Permit degree of contraction and expansion as specified in manufacturer's latest published literature.

4. Gaskets: Mechanical grooved coupling design, pressure responsive so that internal pressure serves to increase seal's tightness, constructed of elastomers having properties as designated by ANSI/ASTM D2000.

   a. Water Services: EDPM Grade E with green color-code identification, ASTM D2000.
   b. Other Services: As recommended by manufacturer.

5. Bolts and Nuts: Heat treated carbon steel, ANSI/ASTM A183, minimum tensile 110,000 psi.

6. Fittings: Grooved or shouldered end design to accept grooved mechanical couplings.

   a. Malleable Iron: ANSI/ASTM A47.
   b. Fabricated Steel: ANSI/ASTM A53, Type F for 3/4" to 1-1/2"; Type E or S, Grade B for 2" to 20".
   c. Steel: ANSI/ASTM A234.

7. Flanges: Conform to Class 125 cast iron and Class 150 steel bolt hole alignment, ASTM A536.

8. Malleable Iron: ANSI/ASTM A47.

9. Grooves: Conform to the following:

   a. Standard Steel: Square Cut.
   b. Cast Iron: Radius cut grooved, ANSI/AWWA C606.

10. Available Manufacturers: Subject to compliance with requirements, manufacturers offering grooved piping products which may be incorporated in the work include, but are not limited to, the following: Stockham Valves & Fittings, Inc.; Victaulic Company of America; Gravlok; Gustin-Bacon; or approved equal.

2.3 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

A. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.

   1. Comply with Section II, Part C, ASME Boiler and Pressure
   2. Vessel Code for welding materials.

B. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by Installer to comply with installation requirements.

   1. Tin Antimony Solder (95-5 solder): ANSI/ASTM B32, Grade 95TA.

2. Silver Solder (15% silver minimum): ANSI/ASTM B32, Grade 96.5TS.

C. Brazing Materials: Except as otherwise indicated, provide brazing materials as determined by Installer to comply with installation requirements.

1. Comply with Section IX, ASME Boiler and Pressure Vessel
2. Code for brazing materials.

D. Gaskets for Flanged Joints: ANSI B16.21; full faced for cast iron flanges; raised face for steel flanges, unless otherwise indicated.

E. Piping Connectors for Dissimilar Nonpressure Pipe: Elastomeric annular ring insert or elastomeric flexible couplings secured at each end with stainless steel clamps, sized for exact fit to pipe ends and subject to approval by plumbing code. Provide as required by plumbing code.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently leak proof piping systems capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/ replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections within 1/16" misalignment tolerance.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other structural and permanent enclosure elements of building; limit clearance to 1/2" where furring is shown for enclosure or concealment of piping but allow for insulation thickness, if any. Where possible, locate insulated piping for 1.0" clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view by locating in column enclosures, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions except as indicated.

C. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures. Install drip pan under piping located above and within 3' horizontally of electrical panels.

D. Piping installed in Plenums:

1. All piping installed in air plenums shall be constructed of materials having a 25/50 flame spread/smoke developed rating or less, or have fire barrier plenum wrap installed to achieve required rating per UL 910. See section 22 07 00 Plumbing Insulation.

E. Piping System Joints: Provide joints of type indicated in each piping system.

1. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp

dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer on male threads at each joint and tighten joint to leave not more than 3 threads exposed. No hard setting pipe thread cement permitted.

2. Braze copper tube and fitting joints where indicated in accordance with ANSI B31.

3. Solder copper tube and fitting joints where indicated in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

4. Weld pipe joints in accordance with ANSI B31 and recognized industry practice and as follows:

   a. Weld pipe joints only when ambient temperature is above 0°F (-18°C).

   b. Bevel pipe ends at a 37.5° angle, smooth rough-cuts and clean to remove slag, metal particles and dirt.

   c. Install welding rings for buttwelded joints (for HP steam only).

   d. Use pipe clamps or tack weld joints with 1" long welds; 4 welds for pipe sizes to 10", 8 welds for pipe sizes 12" to 20".

   e. Build up welds with stringer beam pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow holes and nonmetallic inclusions.

   f. Do not weld out piping system imperfections by tack welding procedures; refabricate to comply with requirements.

   g. At Installer's option, install forged branch connection fittings wherever branch pipe is indicated, or install regular "T" fitting, or install welded branchlet.

   h. At Installer's option, install forged branch connection fittings wherever branch pipe of size smaller than main pipe is indicated; or install regular "T" fitting.

5. Weld pipe joints of steel water pipe in accordance with AWWA C206.

6. Flanged Joints: Match flanges within piping system and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

7. Lead Joint Installation: Tightly pack joint with joint packing material. Do not permit packing to enter bore of finished joint. Clean joint after packing. Fill remaining joint space with one pouring of lead to indicated minimum depth measured from face of bell. After lead has cooled, caulk joint tightly by use of hammer and caulking iron.

8. Hubless Cast Iron Joints: Comply with CISPI 310.

9. Grooved Pipe Joints: Comply with fitting manufacturer's instructions for making grooves in pipe ends. Remove burrs and ream pipe ends. Assemble joints in accordance with manufacturer's instructions.

10. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations and with applicable industry standards:

    a. Heat Joining of Thermoplastic Pipe: ANSI/ASTM D2657.
    b. Making Solvent Cemented Joints: ANSI/ASTM D2235, ANSI/ASTM F402, and ASTM D2855.

11. Install gray and ductile cast iron water mains and appurtenances in accordance with ANSI/AWWA C600.

12. Install concrete pipe in accordance with American Concrete Pipe Association "Concrete Pipe Field Manual."

3.2 CLEANING, FLUSHING, INSPECTING

A. General: Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items. Inspect pressure piping in accordance with procedures of ANSI B31.

B. As soon as the water distribution system has been flushed out as above specified, it shall be sterilized in accordance with the requirements of the Health Department or in the absence of such, by the following method:

1. Introduce chlorine or 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 for 24 hours, as determined by residual chlorine tests at the ends of the lines. Open and close all valves and hydrants while the system is being chlorinated.

2. Tests shall be conducted to determine the plate count after the system has been rinsed of chlorine. The system shall be sterilized and rinsed until a plate count of less than 10 colonies per milliliter is maintained. Three copies of the final test shall be submitted to the owner. Test to confirm an absence of coliform bacteria.

3.3 PIPING TESTS

A. Test pressure piping in accordance with ANSI B31.

B. General: Notify owner's construction supervisor two working days prior to testing and cleaning piping systems. Owner's construction supervisor to witness and approve procedures and results. Provide temporary equipment for testing including pump and gages. Test piping system before insulation is installed wherever feasible and remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.

System	Test Pressure	Remarks	Duration
Below Ground Domestic Water	150 psig	-	8 hr
Above Ground Domestic Water	100 psig	-	8 hr

Sanitary Waste and Vent	10' water	-	2 hr
Pressurized Sanitary Waste and Vent	100 psig	-	2 hr
Storm and Clearwater Waste	10' water	-	2 hr
Pressurized Storm and Clearwater Waste	100 psig	-	2 hr

Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

C. Repair piping systems sections that fail required piping test by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop leak compounds, mastics or other temporary repair methods.

D. Drain test water from piping systems after testing and repair work has been completed

E. Reference other Division 22 sections for piping system sterilization and cleaning procedures required.

F. Prepare test report for each piping system showing piping service, test pressure, test period, required repairs if any, retest data, cleaning and sterilization compounds used. Owner's construction supervisor to witness testing and cleaning procedures and provide approval signature on completed form verifying report data. Submit test report to architect for approval.

END SECTION 22 10 50

DIVISION 22 - PLUMBING
SECTION 22 11 00 – FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Provide a complete system of domestic hot, cold and recirculation water piping as indicated on drawings and in specifications. Provide a new water meter in conformance with city utility requirements.

PART 2 - PRODUCTS

2.1 DOMESTIC HOT, COLD AND RECIRCULATION WATER PIPING:

A. General: Provide piping materials of factory fabricated piping products of sizes, types, pressure and temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by industry standards and governing regulations. Where more than one type of materials or products is indicated, selection is Installer's option.

B. Above Grade Piping: Type "L" hard drawn copper tube with wrought copper fittings and solder joints.

C. Above Grade Piping: Schedule 40 galvanized steel.

D. Below Grade Piping: Cast iron or ductile iron pressure pipe with mechanical joints. Provide 8 mil tube or sheet polyethylene encasement of iron pipe and pipe fittings, AWWA C105.

2.2 SPECIALTIES:

A. Water hammer Arrestors: Provide and locate water hammer arrestors as shown on drawings and at solenoid actuated and quick closing valves, as manufactured by PPP Industries, Sioux Chief, Wade, Watts.

1. Water hammer arrestors shall be of same material as piping system and be full size of piping served.

2. Water hammer arrestors shall be ANSI A112.26.1, ASSE 1010; sized in accordance with PDI WH-201, precharged piston type constructed of hard drawn Type K copper, threaded brass adapter, brass piston with o-ring seals, FDA approved silicone lubricant, suitable for operation in temperature range 35 to 150 degrees F, maximum 250 psig working pressure, 1500 psig surge pressure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves at each branch and valves and shock stops as indicated and as required by SPS 382.40.

B. Provide vacuum breakers and backflow preventers as indicated and as required by SPS 382.41.

C. Extend hot and cold water piping to plumbing fixtures and mechanical fixtures as indicated.

D. Install water hammer arrestors in accessible locations.

3.2 TESTING

A. Before pipes are covered, test entire piping systems at 100 psi hydrostatic pressure for period of 2 hours showing no leaks.

3.3 STERILIZATION

A. Flush entire pipe system with clean potable water until no dirty water appears at outlets. Sterilize system with water and chlorine solution containing at least 250 parts per million of available chlorine. Allow to stand for at least 3 hours. Operate valves within system. Flush solution from system until no chlorine remains.

B. Procedure shall be repeated until bacteria plate count is less than 10 colonies/milliliter for all water piping up to the fire deluge valves, the HVAC make-up valves, and all fixtures. Submit test report to Owner and receive a receipt from Owner prior to occupancy.

END SECTION 22 11 00

DIVISION 22 - PLUMBING
SECTION 22 13 00 – FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Provide complete system of soil and waste piping as indicated on drawings and in specifications.

PART 2 - PRODUCTS

2.1 SOIL WASTE AND VENT PIPING

A. General: Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings and capacities as indicated. Where not indicated, provide proper selection as determined by industry standards and governing regulations. Where more than one type of materials or products is indicated, selection is Installer's option.

B. Above Ground Piping:

1. Service weight cast iron hub and spigot soil pipe with lead and oakum joints.

2. Service weight cast iron no-hub soil pipe with no-hub joints conforming to Cast Iron Soil Pipe Institute 301-72 and be listed by NSF International.

3. Schedule 40 galvanized steel pipe with Class 125 galvanized drainage pattern cast iron screwed joints where Code approved.

4. Copper Tube ASTM B306, Type DWV for Pipe, and cast bronze, Drainage pattern fittings, with soldered joints.

   Solder filler materials ASTM B32 50-50 tin-lead solder.

5. ABS Type DWV Plastic Pipe and Fittings ASTM D2661 pipe and fittings, with solvent cemented joints; DWV plastic fittings patterns shall conform to ASTM D3311. Solvent ASTM D2255.

6. PVC Type DWV Pipe and Fittings ASTM D2665 pipe and fittings, with solvent cemented joints: DWV plastic fitting patterns shall conform to ASTM D3311. Solvent ASTM D2564.

C. Underground Piping:

1. Service weight cast iron hub and spigot soil pipe with lead and oakum joints.

2. Service weight cast iron hub and spigot soil pipe with compression gasket joints conforming to ASTM C564 where Code approved.

3. PVC Type DWV Pipe and Fittings ASTM D2665 pipe and fittings, with solvent cemented joints: DWV plastic fitting patterns shall conform to ASTM D3311. Solvent ASTM D2564.

2.2 SPECIALTIES

A. Soil Waste and Vent

1. Cleanout plugs shall be cast bronze, threads complying with ANSI B2.1.

2. Vent flashing sleeves shall be cast iron caulking type roof coupling for cast iron stacks, cast iron threaded roof type coupling for steel stacks.

3. Floor drains shall be cast iron body and flashing collar with nickel bronze strainer head and secured square hole grate. See plumbing fixture schedule, section 22 42 00.

4. Wall cleanouts shall be cast iron body adaptable to pipe with cast bronze or brass cleanout plug; stainless steel cover including screws.

5. Floor cleanouts shall be cast iron body and frame, with cleanout plug and adjustable round top, nickel-bronze top.

6. Flashing Flanges: Cast iron watertight stack or wall sleeve with membrane flashing ring. Provide underdeck clamp and sleeve length as required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Building Drain Piping: Install building drains as indicated and in accordance with State of Wisconsin Plumbing Code. Lay building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Clean interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. All piping shall be concealed and/or built in walls, etc. except as specifically indicated. Install soil and vent piping pitched to drain at minimum slope of 1/4" per foot where possible and in no case less than 1/8" per foot.

B. Cleanouts shall be installed in sanitary piping as indicated, as required by State of Wisconsin Plumbing Code, at each change in direction greater than 45°, at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping and at base of each vertical soil or waste stack.

C. Vent flashing sleeves compatible with roofing system shall be installed on stacks passing through roof. Secure over stack flashing in accordance with manufacturer's instructions.

D. Provide soil and waste piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated.

E. Floor drains shall be installed at low points of surface areas to be drained with top flush

with finished floor. Where waterproof membranes are being penetrated, properly flash drains to maintain membrane integrity.

F. Soil and waste water piping for humidifier, steam condensate, or other discharge exceeding 140°F shall be metal.

3.2 TESTING

A. Test soil and waste piping systems in accordance with requirements of State of Wisconsin SPS 382.21.

END SECTION 22 13 00

DIVISION 22 - PLUMBING
SECTION 22 14 00 – FACILTY STORM DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Provide complete system of storm water piping as indicated on drawings and in specifications.

PART 2 - PRODUCTS

2.1 STORM WATER PIPING

A. General: Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings and capacities as indicated. Where not indicated, provide proper selection as determined by industry standards and governing regulations. Where more than one type of materials or products is indicated, selection is Installer's option.

B. Above Ground Piping:

1. Service weight cast iron hub and spigot soil pipe with lead and oakum joints.

2. Service weight cast iron no-hub soil pipe with no-hub joints conforming to Cast Iron Soil Pipe Institute 301-72.

3. Schedule 40 galvanized steel pipe with Class 125 galvanized drainage pattern cast iron screwed joints where Code approved.

4. Copper Tube: ASTM B306, Type DWV for pipe, and cast bronze, drainage pattern fittings, with soldered joints. Solder Filler Materials ASTM B32, 50-50 tin-lead solder.

5. ABS Type DWV Plastic Pipe And Fittings ASTM D2662 pipe and fittings, with solvent cemented joints; DWV plastic fitting patterns shall conform to ASTM D3311. Solvent ASTM D2255.

6. PVC, Type DWV Pipe And Fittings: ASTM D2665 pipe and fittings, with solvent cemented joints; DWV plastic fitting patterns shall conform to ASTM D3311. Solvent ASTM D2564.

C. Underground Piping

1. Service weight cast iron hub and spigot soil pipe with compressing gasket joints conforming to ASTM C564 where code approved.

2. ABS Plastic Sewer Pipe: ASTM D2751 pipe and fittings. Solvent ASTM D2235.

3. PVC, Type DWV Pipe And Fittings: ASTM D2665 pipe and fittings, with solvent cemented joints; DWV plastic fitting patterns shall conform to ASTM D3311. Solvent ASTM D2564.

4. High Density Polyethylene corrugated pipe with an integrally formed smooth interior.

5. Pipe and Fittings: Conform to ASTM D1248. Couplings shall be corrugated to match the pipe corrugations. The width shall not be less than 1/2 the nominal diameter of the pipe.

2.2 CLEAR WATER WASTE PIPING

A. General: Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings and capacities as indicated. Where not indicated, provide proper selection as determined by industry standards and governing regulations. Where more than one type of materials or products is indicated, selection is Installer's option.

B. Above Ground Piping:

1. Service weight cast iron no-hub soil pipe with no-hub joints conforming to Cast Iron Soil Pipe Institute 301-72.

2. Schedule 40 galvanized steel pipe with Class 125 galvanized drainage pattern cast iron screwed joints where Code approved.

3. Copper Tube: ASTM B306, Type DWV for pipe, and cast bronze drainage pattern fittings, with soldered joints. Solder Filler Materials ASTM B32, 50-50 tin-lead solder.

4. ABS Type DWV Plastic Pipe And Fittings ATM D2661 pipe and patterns shall conform to ASTM D3311. Solvent ASTM D2255.

5. PVC, Type DWV Pipe And Fittings: ASTM D2665 pipe and fittings, with solvent cemented joints; DWV plastic fitting patterns shall conform to ASTM D3311. Solvent ASTM D2564.

C. Underground Piping:

1. Service weight cast iron hub and spigot soil pipe with compression gasket joints conforming to ASTM C564 where Code approved.

2. ABS Plastic Sewer Pipe: ASTM D2751 pipe and fittings. Solvent ASTM D2235.

3. PVC Type DWV Pipe and Fittings ASTM D2665 pipe and fittings, with solvent cemented joints: DWV plastic fitting patterns shall conform to ASTM D3311. Solvent ASTM D2564.

2.3 SPECIALTIES

A. Cleanout plugs shall be cast bronze, threads complying with ANSI B2.1.

B. Roof drains shall be cast iron body complete with flashing collar and gravel stop, cast iron dome, under deck clamp. See plumbing fixture schedule, specification section 22 42 00.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Building Drain Piping: Install building drains as indicated and in accordance with State of Wisconsin Plumbing Code. Lay building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Clean interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. All piping shall be concealed and/or built in walls, etc. except as specifically indicated. Install storm water piping pitched to drain at minimum slope of 1/4" per foot where possible and in no case less than 1/8" per foot.

B. Cleanouts shall be installed in storm water piping as indicated, as required by State of Wisconsin Plumbing Code, at each change in direction greater than 45°, at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping and at base of each vertical stack. Install floor and wall cleanout covers for concealed piping.

C. Roof drains shall be provided in locations indicated. Locate at low point of surface to be drained. Coordinate installation with roofing work to maintain integrity of waterproof membrane.

3.2 TESTING:

A. Test storm water piping systems in accordance with requirements of State of Wisconsin SPS 382.21.

B. Test clear water waste piping systems in accordance with requirements of State of Wisconsin SPS 382.21.

END SECTION 22 14 00

DIVISION 22 - PLUMBING
SECTION 22 30 00 – PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Work of this section shall conform to requirements of Division 26.

1.2 DESCRIPTION OF WORK

A. Provide Water and Waste Equipment as indicated on drawings and in specifications. Provide factory tested pumps, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. Type, size and capacity of each pump is listed in pump schedule. Provide pumps of same type by same manufacturer.

1.3 SUBMITTALS

A. Product Data: Submit catalog cuts, specifications, installation instructions and dimensioned drawings for components of system.

B. Maintenance Data: Submit maintenance data and spare parts lists. Include this data in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical components shall be listed and labeled by Underwriters Laboratory and comply with NEMA standards. Installation of electrical components shall comply with National Electrical Code.

B. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

PART 2 – PRODUCTS

2.1 WATER SOFTENER

A. General: There shall be an alternate-operating twin softener, which shall produce a constant softened water supply. The softener shall include a brine mixing and storage tank. Each resin vessel shall have grain removal capacity, and rated service flow GPM.

B. Controller: The controller for alternating the resin beds shall take an input signal from a single turbine meter mounted in a housing which is located in the product water line. After a preset volume of water has been measured, the standby unit shall be automatically placed into service while the other unit is regenerated. An electric signal shall operate a normally closed isolation valve.

C. Brine Tank: Brine tank shall have listed minimum salt capacity, and shall be constructed of polyethylene material with polyethylene cover. Brine tank shall have safety overflow float valve and air check system.

1. Resin vessels shall be 125 psig design working pressure fiberglass material, Park International or equal, to contain a full 2 cubic feet of resin plus the gravel to cover the distribution tube and maintain the specified freeboard.

D. WS-2: Equal to Hellenbrand H-200M-150-21, WQA S-100 tested:

10.0	Mineral CF
140,000 gr. (50 LBS)	Med. Salt Capacity
60 gpm/10 psi	Service Flow Rating
58 gpm	Flow Rate @ 10 psi
350 lbs	Brine Tank Salt Storage

Manufacturers: Subject to compliance with requirements, provide commercial water softeners of one of the following: Capitol Water Softener, Culligan International, Hellenbrand, Marlo, or approved equal

2.2 EXTERIOR GREASE INTERCEPTOR

A. General: Provide a 1000 gallon heavy duty grease interceptor for exterior installation complying with SPS 382.34 (5) (c) and suitable for exterior installation.

B. Type: Class 3, construct of 5000 psi concrete with tank design conforming to ASTM C-1227-90 and ASTM 1613-06. Include sanitary tees or baffles at inlet and outlet. All joints shall be sealed watertight.

C. Manholes: Provide 2 manholes, one at each section, with extensions to grade elevation. Covers shall be cast iron, bolted and sealed, equal to NF R6462 or equal. Each cover shall be permanently marked with the words GREASE INTERCEPTOR.

D. Manufacturers: Subject to compliance with requirements, provide concrete grease interceptor as manufactured by Crest Precast Inc. or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which water heaters are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF WATER SOFTENERS

A. General: Set level and plumb, orient so controls and devices requiring service are easily accessible.

B. Piping: Connect piping with unions and shut off valves with bypass line.

C. Field Quality Control: Install, start up and test and adjust in accordance with manufacturer's recommendations.

3.3 INSTALLATION OF GREASE INTERCEPTOR

A. Install grease interceptor where indicated and connect to sewer inlet and outlet piping. Confirm grade elevation and piping inverts. Install in accordance with manufacturer's published installation instructions and per SPS 382.34 (5).

B. Install cleanouts in inlet piping at all changes in direction.

END SECTION 22 30 00

CITY OF MADISON
FIRE STATION #2 ADDITION AND REMODELING
Project No. 2011 009

SECTION 22 42 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Division 22 sections for domestic water and soil and waste piping systems used in conjunction with plumbing fixtures; not work of this section.

1.2 DESCRIPTION OF WORK

A. Provide plumbing fixtures and trim as indicated in this section. The Contractor shall check fixture schedules for convenience but is required to furnish all fixtures complete with trim, etc. necessary to the work and as reasonably indicated or implied.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's pump specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.

B. Maintenance Data: Submit maintenance data and spare parts lists. Include this data in maintenance manual.

1.4 QUALITY ASSURANCE

A. Fixture descriptions are an indication of minimum quality and do not express preference as to manufacturer. Fixtures may be Kohler or Elkay as specified, American Standard or approved equal.

B. Comply with applicable portions of State of Wisconsin Plumbing Code pertaining to materials and installation of plumbing fixtures. Comply with applicable ANSI and PDI standards pertaining to plumbing fixtures, handicapped fixtures and fixture supports.

Provide UL and ARI labels on electric water coolers.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver plumbing fixtures in factory fabricated containers. Handle carefully to prevent breakage, chipping and scoring of finish. Do not install damaged units; replace and return to manufacturer.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. Provide factory-fabricated fixtures of type, style and material indicated. For each fixture provide trim, carrier, seats, valves, etc. as indicated on plumbing fixture schedule and as required for proper operation.

2.2 PLUMBING FITTINGS, TRIM AND ACCESSORIES

A. Where fittings, trim and accessories are exposed, provide bright chrome plated or polished stainless steel units. Provide copper or brass where not exposed.

B. Water Outlets: Provide commercial quality faucets, valves, or dispensing devices of type and size as indicated. Include manual shutoff valves and supply stem pipes to permit outlet servicing without shutdown of water supply system.

C. Vacuum Breakers: Provide where required by Code including locations where water outlets are equipped for hose attachment.

D. P-Traps: Include removable P-traps where drains are indicated for direct connection. All brass sink and lavatory tailpieces and traps shall be 17 gage.

E. Carriers:

1. Lavatory Supports: Cast iron supports, having tubular steel uprights with concealed arms and sleeves, mounted on adjustable headers with escutcheons and complete with heavy cast iron short feet, alignment trusses and mounting fasteners.

F. Fixture Bolt Caps: Provide manufacturer's standard exposed fixture bolt caps to match fixture finish.

G. Escutcheons: Provide chrome plated sheet steel escutcheons with friction clips where fixture supplies and drains penetrate walls in exposed locations.

H. Supplies and Stops for Lavatories and Sinks: Polished chrome plated, loose keyed angle stop having 1/2" inlet and 3/8" o.d. x 12" long flexible tubing outlet and wall flange and escutcheon.

I. Supplies and Stops for Tank Type Water Closets: Polished chrome plated, loose keyed angle stop having 1/2" inlet and 3/8" o.d. x 12" long flexible tubing outlet with collar and wall flange and escutcheon.

PLUMBING FIXTURES

FLOOR DRAIN (FD-1): Smith No. 2010-A round top floor drain with 3" outlet and 6" brass strainer head. Provide cast iron body for all fixtures in mechanical rooms.

FLOOR DRAIN (FD-2): Smith No. 2010-A round top floor drain with 2" outlet and 5" nickel bronze (chrome) plated strainer head.

WATER HAMMER ARRESTOR (SA-1): Smith Hydrotrol bellows type water shock absorber with stainless steel shell complying with ASSE 1010, stainless steel adapter, and male threaded plug. Size as required for specific water service application.

LAVATORY (L-1): Molded countertop with undermount lavatory by Others.
Faucets: Zurn Faucet Single-Handle No. Z81000-XL-18M chrome plated metal construction, adjustable temperature limit stop for hot water, 1.5 GPM, laminar flow, perforated grate drain, with 1-1/4" tailpiece by Proflo or McGuire.
Waste: Kohler K-9000, 1-1/4" cast brass "P" trap.
Color: Selected by Architect.

LAVATORY (L-2): Kohler Hudson model K-2861, Wall mounted white vitreous china lavatory with 4" on center holes. ADA compliant
Faucets: Chicago Faucet Single-Handle No. 2200-4, chrome plated metal construction, adjustable temperature limit stop for hot water, 2.0 GPM, aerator, perforated grate drain, with 1-1/4" tailpiece.
Waste: Proflo or McGuire 1-1/2" cast brass "P" trap.

FOOD GRINDER (FG-1): In-Sink-Erator model Badger 5 XP, automatic reversing 1725 RPM motor stainless steel grinding chamber, cast nickel-chrome cutting elements, 9.5 amps/120 volts/single phase power. Unit mounting shall fit a 3-1/2" to 4" sink opening. Provide cord and plug for standard electrical junction box, with switch operation. 1-1/2" cast brass trap. (MODEL-APPROX 3/4 HP)

SINK (S-1): Elkay Model DLR-432212 Lustertone, 18 gage, 304 stainless steel, self-rim, single compartment sink with undercoating and 3 faucet holes 8 inches spacing, with main faucet centered on sink with pre-rinse faucet to the right, bowl size 19"x16"x 12 1/8" (LxWxD). Strainer basket with neoprene stop and 1-1/2" tailpiece.
1-1/2" cast brass trap.

SINK FAUCET (F-1): Zurn Faucet, Z871B1-XL, polished chrome finish, deck mounted fittings, swing spout, lever handles, and Quarter turn ceramic disk cartridge.

SINK FAUCET (F-2): Zurn Faucets, Z826X1-HCT Deck mounted pre-rinse faucet, quarter turn ceramic with self-closing spray valve, adjustable supply arms with integral checks, and 36" flexible stainless steel hose with insulated handle, protective bumper spray head, pipe support and a hose hook.

WATER CLOSET (WC-1): Zurn, Z5655 BWL, vitreous china, elongated bowl, floor mounted, with 2-1/8" passageway complete with Zurn Z6000PL-HET 1.28 gpm flush valve assembly, gpm. Include Church No.9500SSCT elongated solid plastic seat with check hinge and open front, less cover.
Mounting Height: 17" floor to rim.

SHOWER (SH-1): Field built shower w/ Zurn Z7301-SS-MT-S8 faucet and shower head. Precast terrazzo shower receptor equal to Fiat "Monterey" in a 48"x36" size as noted on drawings and non-standard color of tan marble chips in white cement. Drain as noted on plan (FD-1). Supply Stop & Check equal to Zurn.

SHOWER (SH-2): ADA Modular shower "Aquatic bath" model 1363BFC2P with grab bar and fold up seat. Zurn Z7300-SS-MT-HW-H7 shower valve, hand held showerhead with 24" mounted slide bar and 60" flexible hose. Drain as noted on plan (FD-1). Supply Stop & Check equal to Zurn.

MOP BASIN (MB-1): Fiat Model MSB-2424, 24"x24"x10"D, stainless steel or brass drain, body and combination dome strainer and lint basket.
Chicago Faucet No. 911 fitting with 892-G vacuum outlet and No. 633 handles.
Fiat No. 832-AA hose and hose bracket.
Fiat No. 889-CC mop hanger.
Fiat No. E-77-AA, vinyl bumper guard.

WALL BOX (WB-1) Guy Gray Model T200TPPVCHA "T" series washer box, Chrome plated quarter turn ball valve with ½" sweat connection and integral hammer arresters.

WALL BOX (WB-2) Guy Gray Model SS1B1, Stainless steel ice maker box with sweat quarter turn ball valve.

WALL HYDRANT (WH-1): Woodford Model B65 series, automatic draining, freezeless wall hydrant with 3/4" hose connections, vacuum breaker and key operated valve. Contractor shall be responsible for unit length to suit installation condition.

WALL HYDRANT (WH-2): Wall faucet, Woodford Model 24, inlet 3/4" NPT with 3/4" hose connection, vacuum breaker and wheel handle

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine roughing-in work of domestic water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Rough in shall be coordinated with floor base height. All piping at the wall shall be above the base. Also examine floor and substrates and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping and other unsatisfactory conditions.

B. Install plumbing fixtures of types and where shown and at indicated heights in accordance with drawings, manufacturer's written instructions and roughing-in drawings. Ensure that plumbing fixtures comply with requirements and serve intended purposes.

C. Fasten plumbing fixtures securely to indicated supports or building structure and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid and not subject to pull or push movement.

3.2 CLEAN AND TEST

A. Clean plumbing fixtures of dirt and debris upon completion of installation. Protect fixtures from damage during remainder of construction period.

B. Inspect each unit for damage. Remove and replace damaged units with new units. Test fixtures for proper operation upon water pressurization. Correct or replace malfunctioning units.

C. Furnish special wrenches and other devices necessary for servicing fixtures and trim to Owner. Furnish 1 device for every 10 units.

END SECTION 22 42 00

DIVISION 23 - HVAC
SECTION 23 05 00 - HVAC GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Section 07 84 13 – Through-Penetration Fire stop Systems

1.2 CODES AND PERMITS

A. Perform all work in strict accordance with the requirements of the State of Wisconsin Heating, Ventilation and Air Conditioning Code and State of Wisconsin Plumbing Code. Requirements outlined therein shall be minimum requirements as related to this work.

B. Arrange for Code required inspections and pay for same if not covered by permit costs.

C. Arrange and pay for required meter deposits and utility extension costs.

1.3 DESCRIPTION OF WORK

A. Provide all labor, materials, equipment, tools and services for complete and fully operational systems of heating, ventilating and air conditioning as indicated or reasonably implied by drawings and specifications. If an item is shown or specified, it shall be considered sufficient for inclusion as part of this contract work.

B. Contractor shall verify all job conditions at the site and report any discrepancies to the Engineer immediately.

1.4 WORK PRIORITY AND COORDINATION

A. Contractor, his mechanics and subcontractors shall cooperate with all others so construction may proceed without hindrances and in all cases to the best interests of the Owner. Confer with others regarding any work that may affect this work and arrange piping, ductwork, equipment, etc. in proper relation to that of others. Coordinate prior to installation the arrangement of HVAC work as related to plumbing, fire protection, electrical and general construction work.

1.5 DRAWINGS

A. The drawings are schematic in nature indicating the general location of equipment, ductwork, piping, and apparatus. While the sizes and locations have been indicated, the Contractor shall properly adjust his work to meet conditions as they actually exist on the premises. Equipment, ductwork, and piping arrangements shall provide adequate and acceptable clearance for entry, servicing and maintenance. Minor adjustments shall be discussed with the Engineer with the view to convenience of operation and noninterference with other work. The Engineer reserves the right to change the location of any pipe, duct or piece of equipment to suit conditions, with no added cost to the Owner if the requested change does not modify the scope of work. Should the particular equipment, which any contractor proposes to install, require other space conditions, other utility service, or other structural support than those indicated on the drawings, the Contractor shall arrange for such changes with other affected Contractors and with the Architect. Required changes shall be noted on the submittal cover sheet. Should changes become necessary the Contractor shall make such changes at his expense.

1.6 SUBMITTALS

A. Furnish shop drawings on all items as indicated in individual sections. Indicate specification section number on each submittal. Submittals may be sent in paper form, or electronic form. Refer to section 01 33 00 for general submittal requirements.

B. The contractor acknowledges its responsibility to submit complete shop drawings and other required submittals. Incomplete submittals will be returned to the contractor unreviewed. No time extensions or cost increases will be allowed for delays caused by return of incomplete submittals. Shop drawings for equipment which are noted as being reviewed, or reviewed with comments by the Architect/Engineer shall not be re-checked and shall not supersede Contract Documents or relieve Contractor from responsibility for deviations from the Contract Documents.

C. Furnish 2 sets of Operating and Maintenance manuals for the Owner. Include standard operating instructions and complete repair parts lists for items of equipment and controls. Include a summary of maintenance procedures required monthly, yearly, etc. for all equipment. Include a copy of all stamped submittals at the front of each section. Submit in binders with index and section tabs to Engineer for approval.

1.7 REMODELING WORK

A. Wherever remodeling work or demolition of existing equipment, ductwork, piping, and appurtenances is a part of plans and specifications, Contractor shall visit the site and thoroughly examine all existing conditions. Designated equipment shall be turned over to the Owner at a place and time so designated with all other items removed from the site by the Contractor. Provide all required work necessary for interconnection of existing services with new system and coordinate any down-time with the Owner to minimize disruption to their activities.

B. Contractors shall notify the Architect at least 10 days prior to the bid closing date of any deviations or required changes that are noticed. No allowance for additional costs for work related to existing conditions will be permitted after bidding unless proof of hidden work, breakage or damage could not be determined by inspection or examination by the Contractor.

1.8 HOUSEKEEPING

A. This Contractor shall periodically remove debris caused by his operations. On completion he shall remove all debris from his work and leave same neat and clean, ready for use by the Owner.

1.9 PROTECTION OF MATERIALS AND EQUIPMENT

A. Materials and equipment shall be protected at all times. This Contractor shall be responsible for all damage caused directly or indirectly by his workmen. Pipe and duct openings shall be closed with caps or plugs during installation. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury. At the completion of all work, the equipment shall be thoroughly cleaned and delivered to the Owner in a condition satisfactory to the Engineer.

B. Equipment shall not be used during construction unless approved in writing by the Engineer. Equipment used during construction shall be returned to the original condition, which may include such items as replacing filters, cleaning coils, and cleaning ducts.

1.10 PAINTING

A. All equipment shall have manufacturer's standard baked enamel finish and shall not be job painted "unless otherwise specified". Equipment in finished rooms shall have color selected by Engineer from manufacturer's standard colors. All required touch up painting of prefinished surfaces is by this Contractor.

1.11 MECHANICAL IDENTIFICATION

A. Every piece of equipment, starters, disconnect, etc. shall be stenciled with identifying number and area or rooms served, neatly printed and applied on or near item as approved by Engineer. Motors and equipment nameplates and applicable UL labels shall be in place, free from dirt, grease or paint when Project is turned over to Owner.

B. Label all accessible piping with direction of flow arrows and stenciled 1-1/2" identifying letters or snap-on plastic self-coiling sheets with 1" letters and flow arrows. Stencil with black enamel on a light background or light enamel on a black background. Snap-on plastic labels shall be held firmly in place without the use of adhesive, straps, or tape. Label at intervals of not less than every 30' and at points where piping passes through walls, floors or roofs on both sides of partition.

C. Provide 1-1/4" diameter brass valve tag with stamp engraved piping system abbreviation and sequenced valve number. Attach to valve with brass chain. Provide a neatly typed valve schedule stating valve number, service and location. Furnish copies in operating instruction manuals. Exclude HVAC terminal valves.

1.12 INSTRUCTIONS

A. Instruct user agency personnel in the proper operation and maintenance of systems and equipment provided as part of this project; video tape all training sessions. Include not less than 8 hours of instruction during normal working hours, using the Operating and Maintenance manuals during this instruction. Demonstrate startup and shutdown procedures for all equipment.

1.13 RECORD DRAWINGS

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

PART 2 - PRODUCTS

2.1 QUALITY REQUIREMENTS

A. Items indicated on the drawings and in the specifications are listed by manufacturer in order to describe minimum quality requirements.

B. Materials and equipment shall conform to requirements of Wisconsin Administrative Code.

C. All materials and equipment furnished shall be new and shall be the standard products of manufacturers regularly engaged in the production of HVAC and Controls materials and equipment.

PART 3 - EXECUTION

NOT USED

END SECTION 23 05 00

DIVISION 23 - HVAC
SECTION 23 05 13 - ELECTRICAL PROVISIONS OF HVAC WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of electrical provisions to be provided as mechanical work is indicated in other Division HVAC sections, on drawings and as further specified in this section.

B. Types of work normally recognized as electrical but provided as mechanical, specified or partially specified in this section, include but are not necessarily limited to the following:

1. Motors for mechanical equipment.

2. Starters for roof mounted equipment (provided by manufacturer) and variable frequency drives.

3. Wiring of field mounted control switches and similar mechanical-electrical devices provided for mechanical systems to equipment control panels.

C. Refer to Division 23 Controls sections for control system wiring.

D. Refer to other Division 23 sections for specific individual mechanical equipment electrical requirements.

E. Refer to Division 26 sections for starters, junction boxes and disconnect switches required for motors and other electrical units of mechanical equipment.

1.3 SUBMITTALS

A. Listing, Motors of HVAC Work: Concurrently with submittal of mechanical products listing (23 05 00 HVAC General Provisions and Division 1 requirements), submit separate listing showing rating, power characteristics, application (connected equipment) and general location of every motor to be provided with mechanical work. Submit updated information promptly when and if initial data is revised.

1.4 QUALITY ASSURANCE

A. Coordination With Electrical Work: Wherever possible, match elements of electrical provisions of HVAC work with similar elements of electrical work specified in Division 26 sections. Comply with applicable requirements of Division 26 sections for electrical work of this section that is not otherwise specified.

B. Standards: For electrical equipment and products comply with applicable Wisconsin Electrical Code and the NEMA standards and refer to NEMA standards for definitions of terminology herein. Comply with all applicable requirements of the NEC (NFPA 70), NEMA MG-1, IEEE, and ANSI. All motors shall be U.L. listed for specified service.

PART 2 - PRODUCTS

2.1 MOTORS

A. Manufacturer: Except where item of mechanical equipment (which otherwise complies with requirements) must be integrally equipped with motor produced by another manufacturer, provide equipment motors manufactured by one of the following:

Allis-Chalmers Corporation	Baldor Electric Company
Century Electric Division, Inc.	Louis Allis Div.; Litton Industrial Products, Inc.
Reliance Electric Company	Marathon Electric Manufacturing Corporation

B. Motor Characteristics: Except where more stringent requirements are indicated, comply with the following requirements for motors of mechanical work:

1. Temperature Rating: Rated for 40°C environment with maximum 50°C temperature rise for continuous duty at full load (Class A Insulation).

2. Starting Capability: Each motor capable of making 2 cold and 1 hot starts per hour.

3. Phases and Current Characteristics: Provide squirrel-cage induction polyphase motors for 1/2 Hp and larger and provide capacitor start single phase motors for 1/3 Hp and smaller unless otherwise indicated. Coordinate current characteristics with power specified in Division 26 sections and with individual equipment requirements specified in other Division 23 requirements. For 2 speed motors provide two separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed and until rotation directions have been confirmed.

4. Frequency Characteristics: Variable frequency motors shall be capable of operating between 6-60 HZ. Motors shall be performance matched to variable frequency drives.

5. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

6. Power Factor: 0.85 minimum, without external capacitor correction at full load.

C. Motor Construction: Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.

1. Frames: type "T" or "U".

2. Bearings: Ball or roller bearings with inner and outer shaft seals, externally regreasable for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual sections of Division 23 for fractional Hp light-duty motors where sleeve type bearings are permitted.

3. Enclosure Type: Except as otherwise indicated, provide open dripproof motors for indoor use where satisfactorily housed or remotely located during operation and provide guarded dripproof motors where exposed to contact by employees or building occupants. Provide weather protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 23 for other enclosure

requirements.

D. Overload Protection: Provide built-in thermal overload protection and where indicated provide internal sensing device suitable for signaling and stopping motor at starter.

E. Noise Rating: Provide "Quiet" rating on motors located in occupied spaces of building.

F. Efficiency: All motors 1 HP and above shall be "Premium Efficiency". Provide motors having minimum efficiency as scheduled when tested in accordance with NEMA MG-1 and IEEE Standard 112.

Motor nominal full load efficiency schedule

MOTOR HP	-----Open Drip-Proof Motors------ -------Nominal Motor Speed------- 1200 rpm	1800 rpm	3600 rpm
1	82.5	85.5	80.0
1-1/2	86.5	86.5	84.0
2	87.5	86.5	85.5
3	89.5	89.5	85.5
5	89.5	89.5	86.5
7-1/2	90.2	91.0	88.5
10	91.7	91.7	89.5
15	91.7	93.0	90.2
20	92.4	93.0	91.0
25	93.0	93.6	91.7
30	93.6	94.1	91.7
40	94.1	94.1	92.4
50	94.1	94.1	93.0
60	94.5	94.5	93.6
75	94.5	95.0	94.0

MOTOR HP	----Totally Enclosed Fan-Cooled---- -------Nominal Motor Speed------ 1200 rpm	1800 rpm	3600 rpm
1	82.5	85.5	77.0
1-1/2	87.5	86.5	84.0
2	88.5	86.5	85.5
3	89.5	89.5	86.5
5	89.5	89.5	88.5
7-1/2	91.0	91.7	89.5
10	91.0	91.7	90.2
15	91.7	92.4	91.0
20	91.7	93.0	91.0
25	93.0	93.6	91.7
30	93.0	93.6	91.7
40	94.1	94.1	92.4
50	94.1	94.5	93.6
60	94.5	95.0	93.6
75	94.5	95.4	93.6

G. Name Plate: Provide metal name plate on each motor indicating full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

2.2 STARTERS AND ELECTRICAL DEVICES AND WIRING

A. Motor Starter Manufacturer: Except where item of mechanical equipment must be integrally furnished with motor starter produced by another manufacturer, provide motor starters for mechanical equipment manufactured by single one of the following:

Allen-Bradley Company
Cutler-Hammer, Inc.
Square D Company

B. Motor Starter Characteristics: Comply with NEMA standards and NEC. Provide Type I general purpose enclosures (unless noted otherwise) with padlock ears and with frames and supports for mounting on wall, floor or panel as indicated. Where starter location is not within sight of motor, provide disconnect switch at motor. Provide type and size of starter as shown on electrical drawings (or as recommended by motor manufacturer and equipment manufacturer for applicable protection and start-up condition); refer to individual equipment sections for basic load requirements.

1. Magnetic Starters: Provide magnetic starters for motors 1/2 Hp and larger and for smaller motors where interlock or automatic operation is indicated. Include the following:

   a. Maintained contact push buttons and pilot lights properly arranged for single speed or multispeed operation as indicated.

   b. Trip free thermal overload relays, each phase.

   c. Interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division 23 Controls sections.

   d. Built in 120-volt control circuit transformer, fused from line side, where service exceeds 120 volts.

   e. Externally operated manual reset.

   f. Undervoltage release or protection.

   g. Starters serving motors 25 HP or greater shall be a reduced voltage type. "Soft" start is required for all motors over 25 Hp or provided with electronic "soft start" equipment. See schedules for additional requirements.

2.3 EQUIPMENT FABRICATION

A. General: Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable and removable guards for motor drives, arranged for lubrication and similar running maintenance without removal of guards.

B. Belt Drives: Where indicated or required for speed adjustment, provide V belts of proper

size and number. Belts for motors of 3 Hp or less shall have a capacity of 200% of motor capacity. Belts for motors of 5 Hp and larger shall have a capacity of 175% of motor capacity.

1. Maximum belt speed shall be 5000 fpm.
2. Sheaves shall be fixed type, except Dodge Taper-lock or equivalent may be used prior to final TAB work.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 Hp and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

B. Deliver starters, variable frequency drives, and wiring devices which have not been factory installed on equipment unit to electrical Installer for installation.

END SECTION 23 0513

DIVISION 23 - HVAC
SECTION 23 05 16 - EXPANSION COMPENSATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of expansion compensation products required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Expansion compensation products furnished as part of factory fabricated equipment are specified as part of the equipment assembly in other Division 23 sections.

C. Types of Expansion Compensation specified in this section include the following:
Expansion Loop
Pipe alignment guides

1.3 SUBMITTALS

A. Product Data: Submit catalog cuts, specifications, installation instructions and dimensioned drawings for each type of expansion compensation product. Submit schedule showing manufacturer's figure number, size, location and features for each required expansion compensation product.

B. Shop Drawings: Submit shop drawings for fabricated expansion loops indicating location, dimensions, pipe sizes and location and method of attachment of anchors.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of expansion compensation product. Include this data in Maintenance Manual.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of expansion compensation products of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Comply with standards of the Expansion Joint Manufacturer's Association (EJMA).

PART 2 - PRODUCTS

2.1 EXPANSION LOOP:

A. Fabricate expansion loops in locations as indicated and as determined by installer for adequate expansion of installed piping system. Subject loop to cold spring that will absorb 50% of total expansion between hot and cold conditions. Provide pipe anchors and pipe alignment guides as required.

B. Provide prefabricated expansion loops consisting of elbows, 180° return, and two flexible sections of stainless steel hose and braid. Provide threaded or flanged connections with single or double braid as required to suit system pressure requirements and a minimum of 125 psi rating. Provide pipe anchors and pipe alignment guides as required.

C. Manufacturer: Subject to compliance with requirements; Metraloop by Metraflex company or approved equal.

2.2 PIPE ALIGNMENT GUIDES

A. General: Provide pipe alignment guides on both sides of expansion joints and elsewhere as indicated. Construct with 4-finger spider traveling inside a guiding sleeve, with provision for anchoring to building substrate.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering pipe alignment guides which may be incorporated in the work include, but are not limited to, the following: Advanced Thermal Systems, Inc.; Flexonics Division, UOP, Inc.; Metraflex Company.

PART 3 - EXECUTION

3.1 EXPANSION JOINTS

A. General: Install expansion joints in locations indicated and as determined by installer for adequate expansion of installed piping system. Base expansion on the following. Install in accordance with manufacturer's instructions. Provide pipe anchors and pipe alignment guides as indicated and in accordance with manufacturer's recommendations. Align units properly to avoid end loading and torsional stress.
1. Hot water service: Expansion of: 1.5" /100' steel pipe; 2.0"/100' copper

3.2 EXPANSION LOOPS

A. Install pipe anchors and pipe alignment guides as indicated and elsewhere as determined by installer to properly anchor piping in relationship to expansion loops. Align properly to avoid end loading and torsional stress.

3.3 EXPANSION COMPENSATION FOR RISERS AND TERMINALS

A. General: Install connection between piping mains and risers with at least 5 pipe fittings including tee in main. Install connections between piping risers and terminal units with at least 4 pipe fittings including tee in riser.

END SECTION 23 05 16

DIVISION 23 - HVAC
SECTION 23 05 19 - GAGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Air filter gages are specified in 23 41 00 – Air Treatment Equipment.

C. Air flow stations are specified in Pneumatic/Electric Temperature Controls.

1.2 DESCRIPTION OF WORK

A. Extent of gages required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Gages furnished as part of factory fabricated equipment are specified as part of the equipment assembly in other Division 23 sections.

C. Types of gages specified in this section include the following:

Temperature gages	Thermometer wells
Pressure gages	Pressure gage accessories
P/T test wells (Pete's Plugs)	Flow measuring gages

1.3 SUBMITTALS

A. Product Data: Submit catalog cuts, specifications, installation instructions and dimensioned drawings for each type of meter and gage. Include scale range, ratings and calibrated performance curves, certified where indicated.

B. Maintenance Data: Submit maintenance data and spare parts lists for each type of meter and gage. Include this data in Maintenance Manual.

1.4 QUALITY ASSURANCE

A. UL Compliance: Comply with applicable UL standards pertaining to meters and gages.

B. ANSI and ISA Compliance: Comply with applicable portions of ANSI and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.

C. Certification: Provide meters and gages whose accuracies, under specified operating conditions, are certified by manufacturer.

PART 2 - PRODUCTS

2.1 TEMPERATURE GAGES

A. Manufacturers:

1. Subject to compliance with requirements, provide glass thermometers of one of the following: Ashcroft; Marsh; Trerice (H.O.) Company; Weiss (Albert A.) & Son, Inc.; Weksler; or approved equal.

B. Thermometers for installation BELOW 7' AFF:

1. General: Provide glass thermometers of materials, capacities and ranges indicated, designed and constructed for use in service indicated.

2. Case: Die cast aluminum finished in baked epoxy enamel, glass front, spring secured, 9" long.

3. Adjustable Joint: Die cast aluminum, finished to match case, 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.

4. Tube and Capillary: Red liquid filled, magnifying lens, 2% scale range accuracy, shock mounted.

5. Scale: White faced, permanently etched black markings.

6. Stem: Copper plated steel or brass, for separable socket, length to suit installation.

7. Range: Conform to the following:

Hot Water: 30° to 240°F with 2°F scale divisions.
Air: -20° to 120°F with 2°F scale division

C. Thermometers for installation ABOVE 7' AFF:

1. General: Provide remote mounting dial thermometers of materials, capacities and ranges indicated, designed and constructed for use in service indicated.

2. Case: Die cast aluminum finished in baked epoxy enamel, glass front, back flanged casing, 3-1/2" diameter scale.

3. Connecting tube: Stainless steel capillary with stainless steel interlocked spiral armor. Bottom connection to case.

4. Tube and Capillary: Liquid or gas filled, 2% scale range accuracy, temperature compensated, capable of field calibration.

5. Scale: White faced, permanently etched black markings.

6. Stem: Copper plated steel or brass, for separable socket, length to suit installation.

7. Range: Same as above.

D. Thermometer Wells:

1. General: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to

thermometer well.

2.2 PRESSURE GAGES AND FITTINGS

A. Manufacturer:

1. Subject to compliance with requirements, provide pressure gages of one of the following: Ametek, U.S. Gauge Division; Ashcroft; Marsh Instrument Company, Unit of General Signal; Marshalltown, An Eltra Company; Trerice (H.O.) Company; Weiss (Albert A.) & Son, Inc.; Weksler; or approved equals.

B. Pressure Gages:

1. General: Provide pressure gages of materials, capacities and ranges indicated, designed and constructed for use in service indicated.

2. Type: General use, 1% accuracy, ANSI B40.1 grade A, phosphor bronze bourdon type, bottom connection, recalibration screw, bronze bushed movement.

3. Case: Cast aluminum or brass, glass lens, 4-1/2" diameter.

4. Connector: Brass with 1/4" male NPT. Provide protective syphon when use for steam service.

5. Scale: White coated aluminum face with permanently etched black markings.

6. Range: Conform to the following:

Hot Water: 0-30 psi

C. Pressure Gage Accessories:

1. General: Provide pressure gage cocks between pressure gages and gage tees on piping systems. Construct gage cock of brass with 1/4" female NPT on each end and "T" handle brass plug.

2. Syphon: 1/4" straight coil constructed of brass tubing with 1/4" male NPT on each end.

3. Snubber: 1/4" brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.

D. Pressure/Temperature Test Wells (Pete's Plugs):

1. Provide P/T test wells on piping systems where indicated. Construct of brass plug with 1/4" NPT threads, EDPM or neoprene valve core, knurled cap with strap. Provide 2" extension for insulated piping. Provide 1/4" FPT adaptors for standard pressure gauges.

PART 3 - EXECUTION

3.1 INSTALLATION OF TEMPERATURE GAGES

A. General: Install temperature gages below 7' AFF in vertical upright position and tilted so as to be easily read by observer standing on floor. Install remote read thermostats on a

suitable rigid surface, with readout between 4' to 6' AFF.

B. Locations: Install in the following locations and elsewhere as indicated on drawings:

At water inlet and outlet of each water coil in air handling unit.
At water inlet and outlet of each water heating device/boiler.
At mixed air, and discharge air in each air handling unit.

C. Thermometer Wells: Install in piping tee where indicated, in vertical upright position. Fill well with oil or graphite, secure cap.

3.2 INSTALLATION OF PRESSURE GAGES

A. General: Install pressure gages in piping tee with pressure gage cock, located on pipe at most readable position.

B. Locations: Install in the following locations and elsewhere as indicated on drawings.

At suction and discharge of each pump.

C. Pressure Gage Cocks: Install in piping tee. Install with snubber at pumps or pulsating fluids.

D. Pressure/Temperature wells: Install where indicated on drawings.

END SECTION 23 05 19

DIVISION 23 - HVAC
SECTION 23 05 23 - VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Provide factory fabricated valves recommended by manufacturer for use in service indicated. All valves for a particular service (i.e. hot water ball valves, steam gate valves, etc.) shall be of the same manufacturer, unless supplied with the equipment by the equipment manufacturer.

B. Provide valves as noted of sizes, types and pressure ratings indicated with connections that properly mate with pipe, tube and equipment connections. Provide valve stem extensions where operator will interfere with insulation.

C. Except for steam, butterfly valves (3" and larger) or ball valves (2-1/2" and smaller) may be substituted for gate and globe valves at Contractor's option.

D. Types of valves specified in this section include the following:

Ball	Drain
Coil connection valve package	Swing Check
Lift Spring Check	Balance
Combination	Pressure Reducing
Safety Relief	

1.3 SUBMITTALS

A. Product Data: Submit schedule of valves indicating Manufacturer, Model number, and type, for each service, include catalog cuts, specifications, installation instructions, and dimensioned drawings for each type of valve. Include pressure drop curve or chart for each size and type of valve.

B. Maintenance Data: Submit maintenance data, exploded view, and spare parts lists for each type of valve. Reference Section 23 05 00 – HVAC General Provisions.

1.4 QUALITY ASSURANCE

A. Valves shall comply with MSS manufacturing and marking standards.

PART 2 - PRODUCTS

2.1 GATE VALVES

A. HVAC Water: Use Ball valves.

2.2 GLOBE VALVES

A. HVAC Water: By TCC only.

2.3 BALL VALVES

A. Valve shall have port area equal to or greater than connecting pipe area and shall include blowout proof stem and seat ring designed to hold sealing material.

B. HVAC Water:

1. Threaded or soldered ends 2" and smaller shall be 600 psi WOG, bronze 2 or 3 piece body, chrome plated bronze ball, bronze stem, TFE packing and seats. (Milwaukee BA100/150, Nexus UX or Nibco TS59570)

C. Natural Gas:

1. Threaded ends 2" and smaller shall be 150 psi WOG, bronze 2 piece body, stainless steel ball, bronze stem, TFE packing and seats, UL listed for N.G. service shut-off.

2. 2-1/2" through 4": Cast iron body, flanged ends, bronze bearings, electroless nickel plated cast iron plug with Hycar resilient plug seal, Buna-N stem seal packing, lever actuator, 175 psi W.O.G., U.L. listed for N.G. service shut-off. DeZurik, Homestead, Rockwell, Walworth.

D. Manufacturer: Subject to compliance with the above, one of the following: Apollo; Crane; Fisher; Grinnell; Hammond; Milwaukee; Nibco; Stockham; or approved equal.

2.4 BUTTERFLY VALVES

A. HVAC Water:

1. Use Ball valves.

2.5 DRAIN VALVES

A. HVAC Water; Use ¾" ball valve with threaded hose adaptor where indicated.(Nibco T58570HC)

B. Manufacturer: Subject to compliance with the above, one of the following: Nexus; Fisher; Grinnell; Hammond; Jenkins; Milwaukee; Nibco; Scott; Stockham; Vogt; or approved equal.

2.6 COIL CONNECTION VALVE PACKAGE

A. Coil connection valve package can be used in lieu of separate shut off ball valve, strainer, drain valve, pressure and test plug, and union on the supply; balance/metering valve with manual vent, pressure and test plug(s) on the return.

1. HVAC Water;

a. Supply; Threaded or soldered ends 2" and smaller shall be 400 psi at 250°F, bronze, brass or copper alloy 2 or 3 piece body, chrome plated bronze ball, bronze stem, TFE packing and seats. Valve shall have port area equal to or

greater than connecting pipe area and shall include blowout proof stem and seat ring designed to hold sealing material. Built-in Y strainer and blow-down drain valve and pressure/temperature plug. Equal to Griswold Isolator-S or Nexus UY.

b. Return; 2" and smaller bronze, brass or copper alloy body with calibrated ball, globe or venturi/valve arrangement, integral pointer and calibrated scale to register degree of valve opening, memory stop, drain tapping, threaded or soldered ends, P/T or Shraeder pressure taps with union, adjustable memory stop, suitable for 400 psi 250°F. Equal to Griswold Quickset or Nexus XB.

c. Flex Hose; 2" and smaller, fabric reinforced EPDM core, stainless steel braid reinforcing, brass OT58 fittings with stainless steel ferrule and EPDM seal. Rated for 300 PSI at 265°F Meeting ASTM E 84-00, NFPA 255 and ANSUL/UL 723 &UBC 8-1 fire rating. Length not to exceed 24 inches. Equal to Griswold FR SS or Nexus UFHM.

B. Manufacturer: Subject to compliance with the above Griswold Controls CPP; Nexus Coil Pak OY, or approved equal.

2.7 SWING CHECK VALVES

A. Unless otherwise noted, valves shall be bronze, regrindable seat, with seating angle 40-45°.Valves shall be suitable for installation in a horizontal or vertical line with flow upward. Provide stop plug as a renewable stop for disc hanger, unless otherwise specified. Disc and hanger shall be separate parts, and the disc free to rotate. Hanger pins shall be supported on both ends by removable side plugs.

B. HVAC Water:

d. 2" and Smaller: Class 125, threaded or soldered ends, bronze disc, threaded cap. (Milwaukee 509/1509 or Nibco T-413-B/S-413-B)

e. 2-1/2" and Larger: Class 125, cast iron body, flanged ends, bronze trim, bolted cap, renewable bronze seat and disc. (Milwaukee F2974 or Nibco F918)

C. Manufacturer: Subject to compliance with the above, one of the following: Crane; Hammond; Milwaukee; Nibco; Powell; Stockham; or approved equal.

2.8 LIFT SPRING CHECK VALVES

A. Unless otherwise noted, valves shall be straight pattern bronze body, bronze trim, with stainless steel spring.

B. HVAC Water Service:

1. 2" and Smaller: Class 125, threaded or solder ends. (APCO 300 series or Nibco T480Y)

2. 2-1/2" and Larger: Class 125, cast iron or semi-steel body, wafer or globe flanged type. (APCO 600 series or Nibco F910 series)

C. Manufacturer: Subject to compliance with the above, one of the following: APCO; Mueller; Milwaukee; Nibco; Valmatic; or approved equal.

2.9 BALANCE VALVES

A. 2" and smaller: Bronze or copper alloy body with calibrated ball, globe or venturi/valve arrangement, integral pointer and calibrated scale to register degree of valve opening, memory stop, drain tapping, threaded or soldered ends, P/T or Shraeder pressure taps with integral check valves and seals, adjustable memory stop, suitable for 200 psig water working pressure at 250°F. Manufactured by Armstrong CBV; Bell & Gossett Circuit Setter Plus; Flow Design Inc.; Flowset AccuSetter; Nexus; Taco Accu-Flo; Victaulic series 786/787; or approved equal.

2.10 COMBINATION VALVE (Shut-off/Balance/Check Valve)

A. Cast or ductile iron body for 2" or larger, stainless steel spring, bronze disc with EPDM seat, calibrated memory stop, backseating valve stem, inlet and outlet pressure tappings, capable of being repacked under full line pressure, and suitable for a minimum working pressure of 175 psig at 240°F when used in hot water heating systems. Armstrong Flo-Trex, Bell & Gossett Triple Duty, Taco Multi Purpose Valve, Thrush-Amtrol Tri-Flow, or approved equal.

2.11 PRESSURE REDUCING VALVES

A. HVAC Water: Brass or bronze body, diaphragm operated, with an integral anti-siphon check valve, inlet strainer, and adjustable reduced pressure range but pre-set for the scheduled pressure, 125 psig at 225°F. Bell & Gossett, Cash-Acme, or Watts.

2.12 SAFETY RELIEF VALVES

A. HVAC Water: Iron or bronze body, direct pressure actuated, teflon seat, stainless steel stem and spring, suitable for 125 psig water working pressure at 240° F and ASME stamped, with Btu capacity and relief pressure at 30 psig or as scheduled. (Safety valves by boiler, heat exchanger, etc. equipment supplier). Bell & Gossett, Cash-Acme, Consolidated, Kunkle, Spirax Sarco, Watts.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves according to manufacturer's recommendations. Locate valves so as to be accessible for operating and servicing with access panels provided where required. Install valves with stems horizontal or above. Provide stem extensions where insulation will interfere with valve handle.

B. Provide shutoff valves and unions or flanges on inlet and outlet of each mechanical equipment item. Provide shutoff valves in each primary and secondary branch main to isolate each branch. Shut off valves shall be ball, or butterfly type depending on service.

C. Provide drain valves where indicated and at low points of piping systems and wherever required to completely drain systems including; coils, heat exchangers, pumps, and piping circuits.

D. Provide balancing valves for each hydronic terminal, air handling coils, at the discharge of each pump, and as indicated on drawings and details. After system balance, mark balance valves with stripe of yellow lacquer across body and stop plate.

E. Provide swing check valves where specified, detailed. In such cases, provide isolation valves to allow repair or replacement of check valve.

F. Provide a spring loaded check valve in each pump discharge line and elsewhere as

detailed.

G. A combination shut-off, check and balancing valve may be installed in lieu of separate shut-off valve, check valve, and balancing valve at pump discharge.

H. Provide safety relief valves as indicated, downstream of all pressure reducing valves, and on all boilers. Install valves in the vertical position, with drain holes piped to the nearest drain. Keep pipe between safety valve and drip pan elbow as short and straight as possible. Provide unions at safety relief valves for removal.

I. Provide pressure reducing valves as indicated and detailed.

END SECTION 23 05 23

DIVISION 23 - HVAC
SECTION 23 05 29 – SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 23 05 48 - Vibration isolation used in conjunction with work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of supports, anchors and seals required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Supports, anchors and seals furnished as part of factory fabricated equipment are specified as part of the equipment assembly in other Division 23 sections.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacturer of supports, anchors and seals of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Code Compliance: Comply with applicable ANSI codes pertaining to product materials and installation of supports, anchors and seals for pressure piping.

C. UL and FM Compliance: Provide products that are Underwriters Laboratories listed and Factory Mutual approved.

D. MSS Standard Compliance:

1. Provide pipe hangers and supports of which materials, design and manufacture comply with ANSI/MSS SP-58.

2. Select and apply pipe hangers and supports, complying with MSS SP-69.

PART 2 - PRODUCTS

2.1 MANUFACTURERS OF HANGERS AND SUPPORTS

A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following: Copper B-Line; Erico; Fee & Mason Manufacturing; Grinnell/Anvil International; Caddy, Cooper, Unistrut or approved equal. Grinnell model numbers are listed an example of required quality.

2.2 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory fabricated horizontal piping hangers and supports complying with ANSI/MSS SP-58 of one of the following types

listed, selected by Installer to suit horizontal piping systems in accordance with manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper plated hangers and supports for copper piping systems. For plenum return applications ensure hangers meet UL 2043 flame and smoke testing.

B. Adjustable Steel Clevises: (1/2" - 2") Grinnell Fig. 65 or 260.

C. Saddle w/ U-Bolt: Grinnell Fig. 191 (2" – 6") including steel pipe base support and cast iron floor flange.

D. Clips: Grinnell PS 1100 (Non-Hanging).

E. Pipe Slides and Slide Plates: Grinnell 438, Type 2 and 3.

F. Pipe Guide: Grinnell Fig. 254 or 255.

G. Single Pipe Rolls: Grinnell 171.

H. Adjustable Roller Hangers: Grinnell 181.

I. Pipe Roll Stands: Grinnell 271.

J. Pipe Rolls and Plates: Grinnell 277.

K. Tubing channel clips: Caddy TSM/TSMI or Cooper B-Line BPIC/BPRC series.

2.3 VERTICAL PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory fabricated vertical piping clamps complying with ANSI/MSS SP-69 of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper plated clamps for copper piping systems.

B. Two Bolt Riser Clamps: Grinnell Fig. 261.

2.4 HANGER ROD ATTACHMENTS

A. General: Except as otherwise indicated, provide factory fabricated hanger rod attachments complying with ANSI/MSS SP-69, of one of the following MSS types listed, selected by Installer to suit horizontal piping hangers and building attachments in accordance with manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select type of hanger rod attachments to suit hanger rod size.

B. 1/2" & 3/8": Grinnell 89.

C. 5/8" to 1-1/2": Grinnell 228.

2.5 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory fabricated building attachments complying with ANSI/MSS SP-69 of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with manufacturer's

published product information. Select size of building attachments to suit hanger rods. Provide copper plated building attachments for copper piping systems.

B. Concrete Inserts: Grinnell Fig. 282 and 281.

C. Welded Attachments: Grinnell Fig. 66.

D. Pipe Hanger Flange: Grinnell Fig. 153 (3 hole).

E. Steel Brackets: One of the following for indicated loading:

Light Duty:	(600#)	Grinnell 194
Medium Duty:	(1200#)	Grinnell 195
Heavy Duty:	(2400#)	Grinnell 199

2.6 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory fabricated for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Saddles: Grinnell 160-166A; fill interior voids with segments of insulation matching adjoining insulation.

C. Protection Shields: Grinnell 167; of length recommended by manufacturer to prevent crushing of insulation.

2.7 SPRING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory fabricated spring hangers and supports complying with ANSI/MSS SP-58 and 69, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select spring hangers and supports to suit pipe size and loading.

B. Spring Cushion Hangers: Grinnell Fig. 82.

C. Spring Cushion Roll Hangers: Grinnell Fig. 178.

2.8 ROOF MOUNTED SUPPORT SYSTEMS

A. General: Curb base must be made of 100% recycled rubber and polyurethane prepolymer with a uniform load capacity of 500 pounds per linear foot of support. Base shall be 6 inches wide and 6 ¾ inches high by length required to support multiple pipes. Steel frame shall be 14 gauge strut galvanized per ASTM A653 or 12 gauge strut galvanized per ASTM A653 for bridge series. Attaching hardware to be zinc-plated threaded rod, nuts and attaching hardware per ASTM B633.

B. Equal to Dura-Blok as manufactured by Cooper B-line.

2.9 MISCELLANEOUS MATERIALS

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ANSI/ASTM A36.

C. Cement Grout: Portland Cement (ANSI/ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ANSI/ASTM C404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand by volume with a minimum amount of water required for placement and hydration.

D. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

E. Pipe Guides: Provide factory fabricated guides of cast semi-steel or heavy fabricated steel consisting of a bolted two section outer cylinder and base with a two section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any) and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed.

B. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments. Attachments to structural steel shall be completed prior to installation of structural fireproofing.

3.2 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete or on structural steel prior to installation of structural fireproofing for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69.

B. Install additional building attachments where support is required for additional concentrated loads including valves, flanges, guides, strainers, expansion joints and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping and do not support piping from other piping. Support spacing shall be based on midspan deflection of 0.5" maximum and allowable bending stress of 10,000 psi.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Equipment room piping over 3-1/2" connected to pumps, chillers, or other vibrating equipment shall be supported by spring cushion hangers.

D. Prevent electrolysis in support of copper tubing by use of hangers and supports that are copper plated or by other recognized industry methods.

E. Provisions for Movement: Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

F. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.

H. Insulated Piping: Comply with the following installation requirements:

1. Clamps: Attach clamps to hot water and steam piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
2. Shields: Where low compressive strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields.
3. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.4 INSTALLATION OF ROOF MOUNTED SUPPORT SYSTEMS

A. Install accordance with manufactures instructions and recommendations.

B. If gravel top roof, gravel must be removed around and under pipe support.

C. Always consult roofing contractor manufacturer for roof membrane compression capacities. If necessary, a compatible sheet of roof material (rubber pad) may be installed under rooftop support to disperse concentrated loads and add further membrane protection.

D. Gas piping support spacing subject to local code.

E. Use properly sized clamps to suit pipe size.

3.5 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure prior to installation of structure fireproofing. Comply with ANSI B31 and with AWS standards.

C. Where expansion compensators are indicated install anchors in accordance with expansion unit manufacturer's written instructions to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.6 ADJUSTMENT OF HANGERS AND SUPPORTS

A. Adjust hangers and supports and place grout as required under supports to bring piping to proper levels and elevations.

3.7 EQUIPMENT BASES

A. Concrete housekeeping bases shown on drawings will be provided as work of Division 3. Furnish to Contractor, scaled layouts of all required bases with dimensions of bases and location to column centerlines. Furnish templates, anchor bolts and accessories necessary for base construction.

B. Provide structural steel stands to support equipment as indicated on plans and details. Construct of structural steel members or steel pipe and fittings. Provide factory fabricated tank saddles for tanks mounted on steel stands. Use galvanized steel when exposed to the outside or in steam boiler rooms.

END SECTION 23 05 29

DIVISION 23 - HVAC
SECTION 23 05 48 - VIBRATION ISOLATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of vibration isolation work required by this section is indicated on drawings and schedules and/or specified in other Division 23 sections.

B. Types of vibration isolation products specified in this section include the following:

Type 1: Neoprene Pad
Type 2: Neoprene Mount
Type 3: Unhoused Spring with Neoprene
Type 4: Housed Spring with Neoprene
Type 5: Spring Hanger with Neoprene
Type 6: Precompressed Spring with Neoprene
Type 7: Spring Hanger with Deflection Indicator
Type 8: Spring Hanger with Neoprene
Type AG: Vertical Pipe Anchor and Guide
Type S: Steel Base
Type T: Horizontal Thrust Restraint
Flexible Piping Connections
Flexible Duct Connections

1.3 SUBMITTALS

A. Submit manufacturer's specifications, detailed drawings, performance characteristics data and installation instructions for each type of unit required.

B. Include data for each type and size of unit, showing isolation efficiency, stiffness, natural frequency and transmissibility at lowest operating speed of equipment.

C. For spring units, show wire size, spring diameter, free height, solid compression height, operating height, fatigue characteristics and ratio of horizontal to vertical stiffness.

D. For spring and pad type units show basis of spring rate selection for range of loading weights.

1.4 QUALITY ASSURANCE

A. Product Qualification: Provide each type of vibration isolation unit produced by specialized manufacturer, with not less than 5 years successful experience in production of units similar to those required for project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide vibration isolation products of one of the following: Amber/Booth Co.; Consolidated Kinetics Corporation; Korfund Dynamics Corporation; Mason Industries, Inc.; Vibration Eliminator Company, Inc.; Vibration Mountings and Controls, Inc.; or approved equal.

2.2 ISOLATION MATERIALS AND SUPPORT UNITS

A. **TYPES:** The type of isolator is subsequently described and an equivalent Mason Industries model type is indicated to represent the performance and quality specified. Any manufacturer indicated above may submit their equivalent model.

TYPE 1: NEOPRENE PAD
Neoprene pad, 60 durometer, Bridge bearing quality per AASHO specifications. Minimum 3/4" thick. Equivalent to Mason type BBP.

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

TYPE 3: UNHOUSED SPRING WITH NEOPRENE
Combination freestanding, unhoused spring and neoprene with rib molded antifriction base. Include leveling bolts for securing to the equipment. Springs to be laterally stable under load and selected so they have an additional travel to solid equal to 50% of the rated deflection. Use height saving brackets when appropriate to the application. Equivalent to Mason type SLF.

TYPE 4: RESTRAINED SPRING WITH NEOPRENE
Combination spring and neoprene with rib molded base similar to Type 3 mount above, but with a housing that includes vertical limit stops to prevent spring extension when weight is removed such that the installed and operating heights are the same. Maintain a minimum clearance of 1/2" around restraining bolts, and between the housing and the spring, so as not to interfere with the spring action. Design isolator so limit stops are out of contact during normal operation. Use height saving brackets when appropriate to the application. Equivalent to Mason type SLR.

TYPE 5: SPRING HANGER WITH NEOPRENE
Vibration hanger with a steel spring and 0.3" deflection neoprene element in series. Use neoprene element molded with a rod isolation bushing that passes through the hanger box. Select spring diameters and size hanger box lower holes large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Select springs so they have a minimum additional travel to solid equal to 50% of the rated deflection. Equivalent to Mason type 30N or W30.

TYPE 6: PRECOMPRESSED SPRING HANGER WITH NEOPRENE
Vibration hanger similar to Type 5 but precompressed to the rated deflection to keep the piping or equipment at a fixed elevation during installation. Design hanger with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Equivalent to Mason type PC30N.

TYPE 7: SPRING HANGER WITH DEFLECTION INDICATOR
Steel spring hanger in a steel housing which include a deflection indicator scale, designed to accommodate vertical pipe expansion. Preset hanger at the factory for the required load. Design hanger for 130% of rated deflection but use no more than 100% of rated deflection when selecting the hanger. Equivalent to Mason type HES.

TYPE 8: SPRING HANGER WITH NEOPRENE
Steel spring hanger located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. Neoprene cup to contain a steel washer designed to

properly distribute the load on the neoprene and prevent its extrusion. Design spring diameter and size hanger box lower hole sufficiently large to permit the hanger rod to swing through a 30° arc before contacting the hole perimeter and short circuiting the spring. Select spring so it has a minimum additional travel to solid equal to 50% of the rated deflection. Provide hanger with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps. Equivalent to Mason type W30 or 30N.

TYPE S: STEEL BASE
Structural steel base, rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases which may be "T" or "L" shaped. Include support for suction and discharge base ells for split case pump bases. Use perimeter steel members with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Use height saving brackets in all mounting locations to provide a base clearance of at least one inch above the floor or housekeeping pad. Equal to Mason type WF.

TYPE T: HORIZONTAL THRUST RESTRAINT
Spring element in series with a neoprene pad as described for Type 3 mount with the same deflection as specified for the mounting or hanger. Design the assembly so the spring element is contained within a steel frame, so it can be preset for thrust at the factory, and adjusted in the field for a maximum of 1/4" movement at start and stop. Include threaded rod and angle brackets for attachment to both equipment and ductwork or equipment and structure. Equivalent to Mason type WB.

B. FLEXIBLE PIPING CONNECTIONS

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

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

WATER:
Multiple plies of nylon tire cord fabric reinforced with an EPDM cover and liner. Do not use steel wire or rings as pressure reinforcement. Use threaded or soldered connections for sizes 2" and smaller and floating steel or ductile iron flanges for sizes 2-1/2" and larger; design the steel flange end so the steel flange is recessed to lock a steel wire bead ring in the raised face of the EPDM flange. Construct straight-through connections with twin spheres. Use control rods when recommended by the manufacturer. Equivalent to Mason Super-Flex MF series.

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

C. FLEXIBLE DUCT CONNECTIONS

Provide flexible duct connections wherever ductwork connects to vibration isolated equipment or where otherwise noted. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse and torsional movement and also capable of absorbing vibrations of connected equipment. Materials to be fire retardant, be UL 214 listed, and meet the requirements of NFPA 90A.

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

Construction: Indoor General use; Glass fiber fabric double coated with neoprene, air and water tight, suitable for temperatures between -10 and 200 °F, with a nominal weight of 30 ounces per square yard. Outdoor General outdoor use; Double coated with

Hypalon and suitable for temperatures between -10 to 250 °F, with a nominal weight of 26 ounces per square yard. Corrosive environments or fume exhaust applications indoors or outdoors; Use a material coated with Teflon that is air and water tight, suitable for temperatures between -20 °F and 500 °F and has a nominal weight of 14 ounces per square yard.

2.3 PERFORMANCE

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

	---------- Floor Span or Column Spacing----------							
	--On Grade--		---20 Feet---		---30 Feet---		---40 Feet---	
TYPE OF EQUIPMENT	Iso. Type	Min. Static Defl. In.	Iso. Type	Min. Static Defl. In.	Iso. Type	Min. Static Defl. In.	Iso. Type	Min. Static Defl. In.
AIR-COOLED CONDENSING UNITS:	Bolt to pad		3	0.75	4	1.50	4	2.50
PACKAGED AIR HANDLING UNITS: Floor mounted with internal fan isolation Thru 5 hp	1	0.10	1	0.10	1	0.10	1	0.10
PIPING CONNECTED TO ROTATING OR RECIPROCATING EQUIPMENT:	Flexible piping connections, and type 5 or 6 hangers for a distance of 100 pipe diameters or a distance of three hangers away from the equipment, whichever is greater. Where piping is floor supported, the above requirement apply, but use type 3 mounts instead of type 5 or 6 hangers.							

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading and are not short circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation.

2. Anchor and attach units to substrate and equipment as required for secure operation and to prevent displacement by normal forces and as indicated.

3. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

4. Locate isolation hangers as near overhead support structure as possible.

5. Install flexible duct connectors at air handling equipment greater than 200 cfm capacity. Bond flanges of flexible duct connectors to ducts and housings to provide airtight connections. Seal seams and penetrations to prevent air leakage.

6. Flexible Pipe Connectors: Install on equipment side of shut off valves, horizontally and parallel to equipment shafts wherever possible. Provide at all pumps, AHU coils, and fan coil units.

END SECTION 23 05 48

DIVISION 23 - HVAC
SECTION 23 05 93 - TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of testing, adjusting and balancing work is indicated by requirements of this section and also by drawings and schedules and is defined to include all air distribution systems, hydronic distribution systems and associated equipment and apparatus of mechanical work. The work consists of setting speed and volume (flow), adjusting facilities provided for systems, recording data, conducting tests, preparing and submitting reports and recommending modifications to work as required by Contract Documents.

B. Component types of testing, adjusting and balancing specified in this section includes all "new" HVAC equipment and all smoke control equipment, but is not limited to the following:

Fans	Air Handling Units
Ductwork Systems	Coils
Piping systems	Air Flow Control Valves
Diffusers, Registers and Grilles	

1.3 QUALITY ASSURANCE

A. Balancer shall be firm certified by National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines similar to those required for this project, which is not Installer of system to be tested and is otherwise independent of project.

B. NEBB Compliance: Comply with NEBB's "Procedural Standards for Testing, adjusting and Balancing of Environmental Systems" as applicable to mechanical air hydronic distribution systems and associated equipment and apparatus.

C. Industry Standards: Comply with American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) recommendations pertaining to measurements, instruments and testing, adjusting and balancing, except as otherwise indicated.

D. Acceptable contractors:
- Professional Systems Analysis Inc.
- Environmental Systems Analysis Inc.
- Badger Balancing LLC
- T & B Services Ltd.
- Other independent firm which specializes in the testing and balancing of HVAC systems, is NEBB certified in the specific area of work to be performed, and has performed testing and balancing work for a minimum of 3 years. Qualifications shall be submitted for approval.

1.4 JOB CONDITIONS

A. Coordination: TAB Contractor shall coordinate with HVAC during installation of HVAC work to insure that adequate balancing dampers and valves are provided. Do not proceed with testing, adjusting and balancing work until work has been completed and is operable. Ensure that there is no late residual work still to be completed. Do not proceed until work scheduled for testing, adjusting and balancing is clean and free from debris, dirt and discarded building materials.

1.5 SUBMITTALS

A. Test Report: Prepare report of test results including instrumentation calibration reports and recommendations for correcting unsatisfactory performances in format recommended by applicable original installer. Indicate where necessary, modifications which exceed requirements of Contract. Submit 3 copies to Architect (1 for Architect and 2 for Owner).

PART 2 - PRODUCTS

2.1 PATCHING MATERIALS

A. Except as otherwise indicated, use same products as used by original installer for patching holes in insulation, ductwork and housings which have been cut for test instruments, attaching jigs and similar purposes.

B. At tester's option plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.

2.2 TESTING INSTRUMENTS

A. Utilize test instruments and equipment for TAB work required of type, precision and capacity as recommended in NEBB's standard "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems".

PART 3 - EXECUTION

3.1 TEST, ADJUST AND BALANCE

A. Examine installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable. Do not proceed with TAB work until unsatisfactory conditions have been corrected in a manner acceptable to tester.

B. Test, adjust, and balance systems subsequent to significant system modifications and submit test results. Final quantities shall be within 10% of design conditions, while maintaining required space pressure relationships.

C. Balancing Contractor shall balance adjustable sheave fans to determine permanent fixed sheave size. Retest fans after permanent sheaves have been installed and submit test results.

3.2 PATCHING

A. Patch holes in insulation, ductwork and housings that have been cut or drilled for test purposes. Patch in manner recommended by original installer.

3.3 MARKING

A. Mark equipment settings including damper control positions, valve indicators, fan speed control levers and similar controls and devices to show final settings at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

END SECTION 23 05 93

DIVISION 23 - HVAC
SECTION 23 07 00 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 23 31 13 - Acoustic lined air ducts.

C. Section 23 33 00 – Duct Accessories

1.2 DESCRIPTION OF WORK

A. Provide thermal insulation for piping, ductwork and equipment as specified herein.

B. Insulation thicknesses required for the various system types are as scheduled on plans, as required by the Wisconsin Administrative Code, and as specified herein. In case of conflict, the more rigid requirement shall apply. All insulation thicknesses listed are based on a minimum thermal efficiency (R-Value) with the intent to provide a minimum thermal efficiency.

C. Insulate portions of existing piping, ductwork, and equipment where existing insulation was removed by Owner's abatement contractor and for new connections to existing systems by Division 23 contractor.

D. Wrap grease ductwork and access doors with approved materials and methods by rating agency.

1.3 SUBMITTALS

A. Submit insulation schedule indicating service location, product type (manufacturer), and product thickness. Include performance data for each type of product used.

B. Certifications: Submit certifications, ESR report for material and methods or other data as necessary to show compliance with these specifications and governing regulations.

1.3 QUALITY ASSURANCE

A. Installer shall be firm trained and regularly engaged in the application of mechanical insulations. Installer shall be responsible for all debris, rubbish and damages to building parts caused by his operation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Insulation products: Subject to compliance with requirements, provide products of one of the following: Armstrong; Certainteed; Dow; Knauf; Johns Manville Co.; Owens-Corning; Rubatex; or approved equals.

B. Fire proofing wrap products: Subject to compliance with installation requirements, provide products of one of the following: Thermal Ceramics, Inc.; Unifrax I LLC; 3M or approved equal.

C. Jacketing products: Subject to compliance with requirements, provide products of one of the following: Alumaguard; MFM Building Products; Venture Clad or approved equals.

2.2 FLAME SPREAD/SMOKE DEVELOPED RATING

A. Insulation systems shall have a flame spread/smoke developed rating of 25/50 or less.

2.3 FIBERGLASS PIPE INSULATION

A. Fiberglass pipe insulation shall be rigid heavy density insulation with "K" factor of .23 at 75°F and factory applied fire retardant vapor barrier jacket of white kraft bonded to aluminum foil with fiberglass reinforcing, and self-sealing pressure sensitive adhesive lap. Rated for service to 450°F. Manville Microlok 650.

B. Fiberglass Pipe Fitting Insulation:

1. Pipe fittings and valves shall be insulated with premolded fiberglass fittings or mineral wool cement with ¼" coat of hydraulic setting finishing cement to a thickness equal to adjacent pipe insulation. Vapor seal fittings with fiberglass tape and completely seal with Benjamin Foster 30-35. Preformed PVC jackets may be used.

2. All other pipe fittings and valves may be insulated with fiberglass miter segments of equal thickness of adjoining insulation with ¼" coat of hydraulic setting finishing cement. Vapor seal fittings with fiberglass tape and completely seal with Benjamin Foster 30-35.

2.4 FLEXIBLE ELASTOMERIC PIPE OR EQUIPMENT INSULATION

A. Flexible elastomeric insulation shall have "K" factor of 0.27 at 75°F. Armstrong Armaflex II with Armstrong 520 sealant.

B. Flexible elastomeric pipe insulation fittings shall be fabricated from miter cut piping insulation or sheet insulation.

2.5 FLEXIBLE FIBERGLASS DUCTWORK INSULATION

A. Flexible fiberglass duct wrap shall be blanket type insulation with "K" factor of .27 or less at 75°F, 1.0 lbs./cubic foot density and aluminum foil scrim kraft facing. Manville Microlite.

2.6 RIGID FIBERGLASS DUCTWORK INSULATION

A. Rigid fiberglass ductwork insulation shall be board type insulation with "K" factor of .23 at 75°F, 6.0 lbs./cubic foot density and foil reinforced kraft facing. Owens-Corning Type 705.

2.7 ELASTOMERIC INSULATION

A. Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75 degrees F, minimum compressive strength of 4.5 psi at 25%

deformation, maximum water vapor permeability of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment or ductwork. Armaflex, Halstead 25/50, or equal.

2.8 FLEXIBLE FIBERGLASS EQUIPMENT INSULATION

A. Flexible fiberglass equipment insulation shall be semi-rigid fiberglass with fibers perpendicular to jacketing, "K" factor of .25 at 75°F, 3 lbs./cubic foot density, 450°F temperature rating and factory applied fire retardant vapor barrier jacket of white kraft bonded to aluminum foil with fiberglass. Knauf Elevated Temperature Flex-Wrap.

2.9 KITCHEN GREASE DUCT FIREPROOFING WRAP:

A. Inorganic flexible fiber 2 hour fire rated duct enclosure wrap with zero clearance to adjacent combustible construction, tested per ASTM E2336, and installed per the requirements of an approved ESR report. Submit ESR report.

2.10 ACCESSORIES

A. Bedding Compounds: Non-shrinking, permanently flexible, compatible with insulation.

B. Vapor Barrier Coating: Nonflammable, fire resistant, polymeric resin, compatible with insulation.

C. Insulating Cement: ANSI/ASTM C195, hydraulic setting mineral wool.

D. Wire Mesh: Corrosive resistant metal, hexagonal pattern.

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

2.11 METAL JACKET: 0.016" thick aluminum, or 0.010" thick stainless steel with safety edge.

2.12 FLEXIBLE METAL JACKETING SYSTEM: Laminated, flexible, self adhering without additional mechanical attachment, sheet-type weather proof cover for interior or exterior use, consisting rubberized adhesive for continuous use temperature between -20°F to + 175°F double layer of high density polyethylene reinforcement and a UV resistant aluminum outer surface. Jacketing material is to have a maximum flame spread/smoke developed index of 25/20, per ASTM-E 84 test, 0.0000 perms water vapor permeability rating per ASTM E-96, and mold inhibitors. Material shall have a 10 year manufacturer's warranty to be free from leaks caused from leaks caused by defects in manufacturing when the membrane is installed according to published directions. Color to be natural aluminum or white. Surface to be smooth. Equal to VentrueClad 1577CW.

PART 3 - EXECUTION

3.1 HVAC COLD AND HOT WATER PIPING INSULATION

A. Cold, and hot water piping insulation shall be fiberglass pipe insulation. See schedule for thickness. Omit insulation on hot water piping within radiation enclosures and unit cabinets, on strainer outlet and flexible connections. Insulate flanges, unions, valves and

strainers and cover with PVC jacket for ease of future removal. Cold piping shall be provided with vapor barrier.

3.2 EXTERIOR SUPPLY DUCTWORK INSULATION

A. Exterior supply ductwork shall be insulated per schedule, from rooftop unit casing to roof penetration.

3.3 INTERIOR SUPPLY DUCTWORK INSULATION

A. Interior supply ductwork shall be insulated with rigid exterior fiberglass duct board or flexible fiberglass duct wrap, per schedule. Vapor barrier shall be provided. Provide sound attenuating duct liner with or without perforated metal as specified in Section 23 31 13 and to points indicated on drawings. See schedule for thickness. Interior dimensions of lined ducts to be as noted on drawings.

B. Where preinsulated flexible ductwork is used, wrap uninsulated flex duct connections to sheet metal duct and to diffuser with flexible fiberglass duct wrap.

C. Where uninsulated plenum diffusers are utilized, wrap exterior of plenum with flexible fiberglass duct wrap.

3.4 OUTSIDE AIR DUCTWORK INSULATION

A. Interior outside air ductwork shall be insulated per schedule, with vapor barrier.

3.5 INTERIOR EXHAUST AIR DUCTWORK

A. Exhaust air ductwork shall be insulated per schedule, as specified in Section 23 31 13 (Medium & Low pressure Ductwork) and to points indicated on drawings.

3.6 INTAKE AND EXHAUST PLENUMS INSULATION

A. Intake and exhaust air plenums and louver closure panels shall be insulated as scheduled for outside air ducts.

3.7 EQUIPMENT INSULATION

A. Insulate cold and hot surfaces of equipment as scheduled.

3.8 INSULATION INSTALLATION

A. Install insulation products in accordance with manufacturer's written instructions and in accordance with recognized industry standards to ensure that insulation serves its intended purpose. Clean and dry surfaces prior to installation. Apply when surfaces to be insulated are at room temperature. Use adhesives, sealers, protective finishes, staples, bands, wires, studs, pins, clips, etc. as recommended by manufacturer. Staples or other fasteners that may puncture vapor barrier shall not be used on chilled water, supply air duct or condensate drains. Maintain integrity of vapor barriers. Extend insulation without interruption through walls, floors and similar penetrations, except where otherwise indicated. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation. Do not insulate over nameplates and labels, bevel and seal around such. Fill cracks, joints, seams and depressions with bedding compound or vapor barrier cement. Provide smooth finish on all insulated surfaces.

B. Fiberglass pipe insulation shall be continuous, uninterrupted through the hanger. Hanger shall be sized for the outside diameter of the pipe insulation. Install sheet metal shield between bearing point of hanger and insulation. Provide inserts where required. All Insulation material shall be applied only when ambient temperature is between 40 °F and 110 °F. Adhesive and lap must be free from dirt and water. Pressurize lap seal repeatedly with sealing tool. Wrap end joints with 3" wide vapor barrier tape. Seal off ends of pipe insulation with glass cloth and vapor barrier coating.

C. Flexible elastomeric insulation shall be completely sealed along seams and butt joints with full covering of adhesive on both surfaces to be joined. Insulation shall not be stretched or forced to a longer length. Cover exterior elastomeric insulation with 1 coat of vapor barrier mastic and 2 coats of UV inhibitor paint.

D. Flexible fiberglass duct wrap shall be secured to ducts over 22" in wide with weld pins, cup pins or speed clips on bottom and sides. Fasten in accordance with the latest addition of SMACNA, but not less than 18" on center or less as required to prevent sagging. Butt all seams and joints, cover with 4" tape and staple tape. Vapor seal all seams, joints, and penetrations.

E. Rigid fiberglass ductwork insulation shall be impaled over suitable mechanical fasteners attached 18" on center maximum and secured with speed washers. Seal all joints and cracks with vapor barrier tape.

F. Flexible fiberglass equipment insulation shall be impaled over mechanical fasteners at 18" on center maximum and secured with speed washers. Butt adjacent sections and seal with vapor barrier tape. Apply adhesive and cover with canvas or glass jacketing and seal with vapor barrier coating.

G. Kitchen grease duct fire proofing wrap shall be installed on ductwork and access doors per ESR report for manufacturer's product. Also cover the entire top surface of each grease hood per manufacturer's requirements to maintain the same rating as duct.

3.9 CONDENSATE DRAIN PIPING

A. Condensate drain piping from AHU drain pans, intake and exhaust plenums shall be insulated as scheduled for cold water piping, unless piping is PVC piping.

3.10 REFRIGERANT SUCTION PIPING

A. All refrigerant suction piping shall be insulated as scheduled. Paint insulation to match adjacent insulation. Exterior piping insulation shall be painted with two coats of U.V. protective paint.

3.11 JACKETS

A. PVC jacket:
Lap seams and joints a minimum of 2 inches and continuously seal with welding solvent recommended by jacket manufacturer. Lap slip joint ends 4" without fasteners where required to absorb expansion and contraction. For sections where vapor barrier is not required and jacket requires routine removal, tack fasteners may be used.

B. Flexible metal jacket:
Install per manufactures instructions by preparing the surface by insuring insulation is clean, dry and secured. Apply with appropriate lap joints and supports.

3.12 BREECHING:

A. Fasten insulation over weld pins and secure with washers. Space fasteners not less than 3" from edge or corner and 12" on center longitudinally and 9" on center in the transverse direction. Clip pins back to washer and cover penetrations with tape of same material as jacket. Firmly butt seams or lap joints per manufacturer's requirements and cover with 4" tape of same material as jacket. Seal tape with plastic applicator and secure with staples bands per manufacturer's instructions.

3.13 INSULATION SCHEDULES

Piping Service	**Insulation Type ***	**Insulation Thickness by Pipe Size**				
		1" and smaller	1- ¼ " to1-½"	2" to 4"	5" to 6"	8" and larger
Hot Water Heating	rigid fiberglass	1-½"	1-½"	2"	2"	3-½"
Refrigerant Suction	elastomeric	½"	1"	1-½"	1-½"	1-½"
Cool. Coil Condensate	rigid fiberglass	1"	1"	1"	1"	1"

* Provide a protective metal jacket for all insulated piping exposed to the weather and installed at less than 6' AFF near walk paths and equipment access in mechanical rooms.

Duct Service	**Insulation Type**	**Thickness**
Outside air ducts	rigid fiberglass	2"
Mixed air and relief air ducts	rigid fiberglass	1.5"
Exposed supply and return ducts	rigid fiberglass	1.5"
Concealed supply ducts	flexible fiberglass	2"
Plenum slot diffusers	flexible fiberglass	2"
Exhaust ducts downstream of motorized backdraft dampers	rigid fiberglass	1"
Exhaust ducts exposed to weather	rigid fiberglass w/ jacket	2"
Supply ducts exposed to weather	rigid fiberglass w/ jacket	3"
Kitchen grease ducts (concealed)	fireproofing	see text
Kitchen Type I hood top	fireproofing	see text

* Exposed supply branch ducts located in the space they are serving do not require insulation. Exposed supply main ducts running through spaces they serve shall be insulated as exposed supply ducts scheduled above. Double wall ducts do not require insulation.

** Exposed return ducts located in the space they are serving do not require insulation. Exposed return ducts located in Mechanical rooms shall be insulated as exposed ducts scheduled above. Double wall ducts do not require insulation.

Equipment Type	**Insulation Type**	**Thickness**
Air separators (Hot Water)	rigid fiberglass	2-½"
Compression tanks	rigid fiberglass	1"
Pumps and strainers	rigid fiberglass	1-½"

END SECTION 23 07 00

DIVISION 23 - HVAC
SECTION 23 11 23 - NATURAL GAS PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. Extent of natural gas piping system work is indicated on drawings and by requirements of this section.

B. Natural gas piping systems include the following:

1. Provide gas piping system from existing mains and take-offs to new gas fired equipment as shown on drawings.

1.3 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of natural gas piping products of types, materials and sizes required whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least 3 years of successful installation experience on projects with natural gas piping system work similar to that required for project.

C. ANSI Code Compliance: Comply with applicable provisions of ANSI B31 "Fuel Gas Piping."

D. National Fuel Gas Code Compliance: Comply with applicable sections of NFPA 54 (ANSI Z223.1) "National Fuel Gas Code" and ANSI Z223.1a "Supplement to National Fuel Gas Code."

E. Local Utility Compliance: Comply with installation requirements of local utility company.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's data for gas piping systems materials and products.

PART 2 - PRODUCTS

2.1 NATURAL GAS PIPING MATERIALS AND PRODUCTS:

A. General: Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings and capacities as indicated. Where not indicated, provide proper selection as determined by installer to comply with installation requirements. Provide materials and products complying with ANSI B31. Where applicable use 150% of base pressure rating on natural gas piping system as maximum design pressures with a minimum of 125 psig. Provide sizes and types matching piping and equipment

connections; provide fittings of materials that match pipe materials used in natural gas piping systems. Where more than one type of material or product is indicated, selection is installer's option.

2.2 BASIC PIPE, TUBE AND FITTINGS:

A. General: Prior to any welding of metallic pipe Contractor shall prove, upon request, welder has required ASME certifications, and prior to any welding of nonmetallic pipe Contractor shall prove, upon request, welder has been certified in accordance with Federal regulations.

B. Building Distribution Piping (above grade and to 8" below slab):

1. Pipe: Black steel pipe, ASTM 53 (Schedule 40), type E or S.
2. Fittings-2" or smaller: ASTM A197/ANSI B16.9 class 150 black malleable iron threaded.
3. Fittings-larger than 2": ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless carbon steel welded.

2.3 SPECIAL VALVES:

A. General: Shutoff valves shall be U.L. listed for natural gas systems and shall include the following:

1. Threaded ends 2" and smaller shall be 150 psi WOG, bronze 2 piece body, stainless steel ball, bronze stem, TFE packing and seats, UL listed for N.G. service shut-off.

2. Pressure Reducing Valves: Provide gas PRV valves for all equipment that cannot accept the distributed gas pressure of 14" W.C. Valves shall be AGA and NFPA compliant for appropriate indoor or outdoor installation, temperature, pressures and sizes required.

B. Manufacturer:

1. Subject to compliance with requirements, provide gas cocks of one of the following: DeZurik; Unit of General Signal; Homestead Industries, Inc., Valve Division; Jenkins Bros.; Lunkenheimer Company, Division of Conval Corp.; NIBCO, Inc.; Powell Company; Walworth Company; or approved equal.
2. Subject to compliance with requirements, provide Pressure reducing valves of one of the following: Sensus; Fischer; Rockwell Manufacturing Company or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF NATURAL GAS PIPING:

A. General: Install natural gas distribution piping in accordance with applicable codes.

B. All gas piping within the building shall be exposed and not concealed within walls or below slabs unless approved by Engineer.

C. Contractor is responsible for field verifying natural gas pressures of existing systems prior to making any new connections. Report any discrepancies to the Engineer.

D. Welded Joints: Welding: Quality welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9 as applicable, for shop and project site welding of piping work. Certify welding of piping work using the Standard Procedure Specifications by and welders tested under supervision of the National Certified Pipe Welding Bureau (NCPWB).

E. Use sealants on metal gas piping threads that are chemically resistant to natural gas. Use sealants sparingly and apply to only male threads of metal joints.

F. Remove cutting and threading burrs before assembling piping. Do not install defective piping or fittings. Do not use pipe with threads that are chipped, stripped or damaged.

G. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping or equipment connections are completed.

H. Ground gas piping electrically and continuously within project and bond to ground connection.

I. Install 4" drip leg, shut-off cock, and union at each equipment connection.

J. Install "Tee" fitting with bottom outlet plugged or capped at bottom of pipe risers.

K. Use dielectric unions where dissimilar metals are joined together.

L. Install piping with 1" drop in 60' pipe run (0.14%) in direction of flow.

M. Install piping parallel to other piping, but maintain minimum of 12" clearance between gas piping and steam or hot water piping above 200°F. Maintain clearance to other hot surfaces.

3.2 INSTALLATION OF VALVES:

A. Gas Cocks: Provide at connection to gas train for each gas fired equipment item, up stream of each PRV, on risers and branches and where indicated.

B. Locate gas cocks where easily accessible and where they will be protected from possible injury.

C. Pressure Reducing Valves: Install PRV for each gas-fired burner per manufacturer's recommendations. Provide venting per code. Vent regulators provided with equipment. PRV's located outdoors shall be installed to prevent moisture from entering vent.

3.3 EQUIPMENT CONNECTIONS:

A. General: Connect gas piping to each gas fired equipment item with drip leg, shutoff gas cock and union. Comply with equipment manufacturer's instructions. Install gas pressure regulator and upstream strainer at each equipment connection, as required. Provide flexible connections where required by code.

B. Verify appropriate gas pressures before initial start-up of any connected equipment.

3.4 PIPING TESTS:

A. Test natural gas piping in accordance with NFPA 31.

1. Test entire piping system with air at 100 psig for 8 hours. Provide temporary

equipment for testing including pump and gages. Prior to test protect controls, burners and appliances by temporarily removing the device or closing shutoff valve at the burner and appliance.

2. Purging of lines and recharging of lines shall conform to NFPA 54 or local utility standards.

3. Notify owner's construction supervisor two working days prior to testing and cleaning piping systems. Owner's construction supervisor to witness and approve procedures and results. Provide Owner with written report of test results indicating time, date, pressure, and temperature at the start and conclusion of the test.

END SECTION 23 11 13

DIVISION 23 - HVAC
SECTION 23 20 01 - PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of piping specialties required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Types of piping specialties specified in this section include the following:

Pipe Escutcheons
Sleeves Sleeve Seals

C. Piping specialties furnished as part of factory fabricated equipment are specified as part of the equipment assembly in other Division 23 sections.

PART 2 - PRODUCTS

2.1 MANUFACTURED PIPING SPECIALTIES

A. General: Provide factory fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service or if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated and connections which properly mate with pipe, tube and equipment connections. Where more than one type is indicated, selection is Installer's option.

B. Pipe Escutcheons:

1. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

2. Pipe Escutcheons for Moist Areas: For waterproof floors and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

3. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

C. Fabricated Piping Specialties:

1. Pipe Sleeves: Provide pipe sleeves of one of the following:

a. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams or welded longitudinal joint. Fabricate from the following gages: 3" and smaller, 20 gage; 4" to 6", 16 gage; over 6", 14 gage.

b. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.

c. Iron Pipe: Fabricate from cast iron or ductile iron pipe; remove burrs.

2. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls below grade, roof penetrations or in exterior walls of one of the following:

a. Mechanical Sleeve Seals: Modular mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

D. Manufacturer: Subject to compliance with requirements, offering mechanical sleeve seals which may be incorporated in the work include, but are not limited to, the following: Thunderline Corporation or approved equal.

1. Sleeve Seals: Provide sleeve seals for sleeves located in interior walls, floors or other interior construction penetrations of one of the following:

a. Mechanical Sleeve Seals: Modular mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

b. Mineral Wool and Caulk: Pack space between sleeve and pipe with mineral wool and an expandable fire retardant caulk or putty 1/2" at each end.

c. Fire Barrier Penetration Seals:

1. Cracks, Voids or Holes Up to 4" Diameter: Use putty or caulking, one piece an expandable elastomer, noncorrosive to metal, compatible with synthetic cable jackets and capable of expanding 10 times when exposed to flame or heat, UL listed.

2. Openings 4" or Greater: Use sealing system capable of passing 3 hour fire test in accordance with ASTM E 814, consisting of wall wrap or liner, partitions and end caps capable of expanding when exposed to temperatures of 250-350°F, UL listed.

d. Manufacturer: Subject to compliance with requirements, provide sleeve seals of the following: Dow Corning; General Electric 850, 851(Pensil); Flamemaster Flamastic 77; C & R Blaze Barrier; Nelson Electric Flameseal Putty; 3M CP25 Caulk, 303 Putty; Thomas and Betts Flamesafe; Thunderline Corporation; U.S. Gypsum Thermafiber; or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF MANUFACTURED PIPING SPECIALTIES

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through floors, walls, partitions and ceilings where penetration is exposed to view (except within mechanical equipment room); and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole and is flush with adjoining surface.

3.2 INSTALLATION OF FABRICATED PIPING SPECIALTIES

A. Sleeves:

1. Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings and roofs. Do not install sleeves through structural members of work except as detailed on drawings or as reviewed by Architect/Engineer. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve including allowance for thermal expansion; but not less than 2 pipe sizes larger than piping run. Where insulation includes vapor barrier jacket, provide sleeve with sufficient clearance for installation. Install length of sleeve equal to thickness of construction penetrated and finish flush to surface; except floor sleeves. Extend floor sleeves 1/4" above level floor finish and 3/4" above floor finish sloped to drain. Provide temporary support of sleeves during placement of concrete and other work around sleeves and provide temporary closure to prevent concrete and other materials from entering sleeves.

   a. Install sheet metal sleeves at interior partitions.
   b. Install steel pipe sleeves at all floor slabs and at all fire rated (1 hour or greater) walls.
   c. Install iron pipe sleeves at exterior penetrations, both above and below grade.

B. Sleeve Seals: Install sleeve seals of type indicated in all pipe sleeves. Interior nonfire-rated nonacoustical partition wall sleeve seals may be deleted.

1. Provide fire barrier seals at walls to match wall fire rating.
2. Provide mechanical sleeve seals at all below grade sleeves.
3. Provide caulked sleeve seals at all above grade exterior wall sleeves and at all mechanical & electrical equipment room walls (not noted above) and at all floor slabs (not noted above).

END SECTION 23 20 01

DIVISION 23 - HVAC
SECTION 23 21 13 - HYDRONIC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to other Division 23 sections for valves, insulation, and accessories.

1.2 DESCRIPTION OF WORK

A. Provide complete systems of cold, chilled water, and hot water piping as indicated on drawings and in specifications.

B. Types of hydronic specialties specified in this section include the following:

Pipe and fittings	Air vent
Air separator	Expansion tank
Pump suction diffuser	Shot feeder
Strainer	Chemical treatment

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of hydronic specialty. Include pressure drop curve or chart for each type and size of hydronic specialty. Submit schedule indicating manufacturer's figure number, size, location, rated capacities and features for each required hydronic specialty.

B. Shop Drawings: Submit manufacturer's assembly type shop drawings indicating dimensions, weights, required clearances and method of assembly of components.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of hydronic specialty. Include this data, product data and shop drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 COLD & HOT WATER PIPING

A. Provide piping materials and factory fabricated piping products of sizes, types, pressure and temperature ratings, and capacities as indicated. Where more than one type of materials or products is indicated, selection is Installer's option. Do not mix types of material or product on the same hydronic system (for example: choose copper OR steel for each separate system).

B. Sizes 2" and smaller may be ASTM A53 standard weight Schedule 40 black steel pipe with ASTM A126 Class 125 cast iron threaded fittings.

C. Sizes 2" and smaller may be ASTM B88 seamless Type L hard temper copper tube with ANSI B16.22 wrought copper fittings and solder joints (use 95/5 solder for water systems). Mechanically formed tees may be used for branch takeoff up to ½ the diameter of the main. Press fittings of copper and copper alloy using factory installed EPDM sealing elements may be used and shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117.

D. Sizes 2-1/2" and larger shall be Schedule 40 black steel pipe with wrought steel butt welding fittings. Welded branchlets permitted.

E. Sizes 2-1/2" though 4" may be ASTM B88 seamless Type L hard temper copper tube with ANSI B16.22 wrought copper fittings and BRAZED joints (use silver solder for water systems). Mechanically formed tees may be used for branch takeoff up to ½ the diameter of the main.

F. Coil condensate piping shall be schedule 40 galvanized steel, copper or PVC DWV.

2.2 SPECIALTIES

A. General: Provide factory fabricated hydronic specialties recommended by manufacturer or as indicated for use in service indicated. Provide hydronic specialties of types and pressure ratings indicated for each service, or if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated and connections, which properly mate with pipe, tube and equipment connections. Where more than one type is indicated, selection is Installer's option, but more than one type cannot be used on project.

B. Air Vent:

1. Manual Vent: Provide manual air vent valves designed to be operated manually with screwdriver or thumbscrews, 1/8" NPS connection, rated at not less than 125 psig at 220°F.

   NOTE: Provide 1/2" vent valves at the high points of AHU coils, heat exchangers, etc in addition to the smaller vents noted above.

2. Manufacturer: Subject to compliance with requirements, provide vent valves of one of the following: Armstrong Machine Works; Bell & Gossett ITT; Eaton/Dole; Spirax Sarco; or approved equal.

C. Air Separators:

1. Provide air separators pressure rated for 125 psig at 220°F and suitable for operating temperature to 300°F. Select capacity based on total system gpm with maximum 1 psi (2.31 Ft) pressure drop.

2. Inline Air Separator: Provide inline separator, cast iron construction, with top vent and bottom drain.

3. Manufacturer: Subject to compliance with requirements, provide air separators of one of the following: Amtrol, Inc.; Spirax/Sarco; Bell & Gossett ITT, or approved equal.

D. Expansion Tanks:

1. Provide sealed pressurized bladder-type tanks of size and number indicated. Construct of steel for 125-psi pressure rating complying with ASME Boiler and Pressure Vessel Code and stamped with "U" symbol. Provide butyl rubber diaphragm capable of field replacement, charging valve, automatic air vent, and drain valve with threaded hose connection.

2. Manufacturer: Subject to compliance with requirements, provide compression tanks and tank fittings of one of the following: Amtrol, Inc.; Bell & Gossett ITT, or approved equal.

E. Pump Suction Diffusers:

1. General: Provide pump suction diffusers as indicated. Construct unit with angle pattern cast-iron body, threaded for 2" and smaller, flanged for 2-1/2" and larger, pressure rated for 125 psi at not less than 250°F. Provide inlet vanes, galvanized or stainless strainer with 3/16" diameter openings with total free area equal to or greater than 5 times cross sectional area of pump suction, flanged cover for strainer removal, inlet tap for pressure gage, blow down tap, provision for support foot, and magnet insert. Provide disposable fine mesh brass or bronze start-up strainer to fit over cylinder strainer.

2. Manufacturer: Subject to compliance with requirements, provide pump suction diffusers on one of the following: Bell & Gossett ITT, Grundfos, or approved equal.

F. Valves: Reference Section 23 05 23 Valves.

G. Shot Feeders:

1. General: Provide shot feeders of 5 gallon capacity or otherwise as indicated, constructed of cast iron or steel, for introducing chemicals in hydronic system. Provide funnel and valve on top for loading, drain valve in bottom and recirculating valves on side. Construct for pressure rating of 125 psi.

2. Manufacturer: Subject to compliance with requirements, provide shot feeders of one of the following: Culligan USA; Vulcan Laboratories, Subsidiary of Clow Corp.; York-Shipley, Inc.; or approved equal.

H. Strainers:

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

2. Manufacturer: Subject to compliance with requirements, provide strainers of one of the following: Armstrong; Hoffman; Keckley; Metraflex; Mueller; Spirax Sarco; Watts Regulator Co.; or approved equal.

I. Cleaning, Flushing and Chemical Treatment: Refer to section 23 25 00 – Chemical Treatment

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cold & Hot Water Piping:

1. General: Install hydronic piping in accordance with recognized industry practices which will achieve permanently leak proof piping systems capable of performing indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/ replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections within 1/16" misalignment tolerance. Support hydronic piping systems in accordance with related Division 23 Sections.

2. Install all piping parallel to building walls and ceilings and at heights which do not obstruct other trades or any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of piping with fire protection piping, ductwork, conduit and equipment of other trades to allow sufficient clearances.

3. Install piping with 1" minimum rise in 40' pipe run in direction of flow. Install drains through out systems to permit complete drainage. Locate groups of pipes parallel to each other. Install eccentric reducers where pipe is reduced with tops of pipes flush. Connect branch piping to mains at centerline of mains or at a 45° angle upward. Connect piping to all mechanical equipment as indicated and as recommended by equipment manufacturer.

4. Do not route piping through transformer vaults, elevator equipment rooms, or above transformers, panel boards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment. Where the above condition is unavoidable, provide drain pan and side shields to protect equipment from dripping or spraying.

5. Use a thread lubricant when making threaded pipe joints; no hard setting pipe thread cement or caulking will be allowed. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces when making copper pipe joints. Clean fitting and tube with metal brush, emery cloth or sandpaper. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main. When making grooved pipe connections lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's specifications. When making press fitting connections cut pipe square, remove scale, slag, dirt and debris from inside and outside of tubing. Deburr end with deburring tool. Tubing end shall be clean and dry. Inspect fitting for proper coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's specifications.

6. Welding: Quality welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9 as applicable, for shop and project site welding of piping work. Certify welding of piping work using the Standard Procedure Specifications by and welders tested under supervision of the National Certified Pipe Welding Bureau (NCPWB).

B. Specialties:

1. Air vents: Provide manual air vents on each hydronic terminal, on top of each riser and at high points in systems. Install ball valve upstream of vent where terminal unit isolation valves are not present. Where located on terminal heating unit air vents for heating elements include air chamber at high point of heating element, concealed in cabinet where possible, at least 1-1/4" x 8" with brass pet cock below heating element; with 1/4" connection to heating element. Provide one key for each 10 pet cocks (delivered to owner). Provide soft copper tubing with pigtail to accessible location.

2. Air Separator: Install air separator in pump suction lines. Connect inlet and outlet piping. Run piping to compression tank with 1/4" per foot (2%) upward slope towards tank. Install blow down valve and piping. Remove and clean strainer after 24 hours and again after 30 days of system operation.

3. Expansion Tanks: Install bladder tanks on concrete pad or as indicated on the drawings. Make piping connections per manufacturer's requirements with isolation valve, drain valve and pressure gauge.

4. Pump Suction Diffusers: At Installer's option, install pump suction diffusers on each pump suction line in lieu of separate strainer, reducing elbow, entrance pipe (minimum of 5 pipe diameters) and pressure gage outlet. Install on pump suction inlet, adjust foot support to carry weight of suction piping. Install nipple and shutoff valve in blow down connection. After cleaning and flushing the hydronic piping system, but before balancing of hydronic piping system, remove disposable fine mesh strainer, clean magnet, and replace with standard mesh strainer.

5. Shot Feeders: Install shot feeders on each hydronic system across pump suction and discharge, and elsewhere as indicated. Provide floor stand or wall support. Install in upright position with top of funnel not more than 48" above floor. Pipe drain to nearest plumbing drain.

6. Strainers: Y Type Strainers: Install Y type strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shutoff valve in strainer blow down connection, full size of connection, except for strainers 2" and smaller installed ahead of control valves feeding individual terminals. Where indicated, provide drain line from shutoff valve to plumbing drain, full size of blow down connection. Locate Y type strainers in supply line ahead of the following equipment and elsewhere as indicated, if integral strainer is not included in equipment:

Pumps	Temperature control valves
Temperature or pressure regulating valves	Pressure reducing valves

END SECTION 23 21 13

DIVISION 23 - HVAC
SECTION 23 21 23 - HVAC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 23 05 13 – Electrical Provisions of HVAC Work

C. Section 23 21 13 – Hydronic Systems

D. Section 23 05 23 - Valves

1.2 DESCRIPTION OF WORK

A. Provide factory tested pumps, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. Type, size and capacity of each pump are listed in pump schedule. Provide pumps of same type by same manufacturer.

1.3 QUALITY ASSURANCE

A. UL and NEMA Compliance: Provide electric motors and products which have been listed and labeled by Underwriters Laboratories and comply with NEMA standards.

B. Certification, Pump Performance: Provide pumps whose performances, under specified operating conditions are certified by manufacturer.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's pump specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.

B. Maintenance Data: Submit maintenance data and spare parts lists for each pump. Include this data in maintenance manual.

PART 2 - PRODUCTS

2.1 IN-LINE CIRCULATOR PUMPS:

A. General: Provide in-line circulator pump where indicated with capacity as shown on plans.

B. Type: Horizontal, permanently lubricated, designed for 125 psi working pressure, 225°F continuous water temperature and specifically designed for quiet operation.

C. Body: Cast iron with bronze fittings.

D. Shaft: Steel, ground and polished, integral thrust collar.

E. Bearings: maintenance free permanently lubricated bearing system.

F. Seal: Mechanical, with carbon seal face rotating against ceramic seat.

G. Motor: Non-overloading at any point on pump curve, open, drip-proof, sleeve bearings, quiet operating, rubber mounted construction, built-in thermal overload protection.

1. See Section 23 05 13 for efficiency requirements
2. See schedule on drawings for pump requiring variable frequency drives.

H. Coupling: Self-aligning, flexible coupling.

I. Manufacturer: Subject to compliance with requirements, provide in-line booster pumps of one of the following: Grundfos; Bell & Gossett, no substitutions allowed.

PART 3 - EXECUTION

3.1 INSTALLATION OF PUMPS

A. Install pumps where indicated, in accordance with manufacturer's published installation instructions, with recommended clearances provided for service and maintenance.

B. Provide piping, accessories, hangers, supports, anchors, valves, meters, gages, vibration isolation as indicated for complete installation.

C. Check alignment and where necessary realign shafts of motors and pumps within recommended tolerances by manufacturer's service representative.

D. Startup pumps in accordance with manufacturer's instructions.

END SECTION 23 21 23

DIVISION 23 - HVAC
SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of refrigerant piping work is indicated on drawings and schedules and by requirements of this section.

B. Insulation of refrigerant piping is specified in other Division 23 sections and is not work of this section.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of refrigerant piping products, of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with refrigerant piping work similar to that required for project.

C. Codes and Standards:

1. ANSI Compliance: Fabricate and install refrigerant piping in accordance with ANSI B31.5 "Refrigeration Piping."

2. ASHRAE Compliance: Fabricate and install refrigerant piping in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration."

D. Submittals:

1. Product Data: Submit manufacturer's technical product data and installation instructions for refrigerant piping materials and products.

2. Brazing Certification: Certify brazing procedures, brazers and operators in accordance with ASME standards (ANSI B31.5).

3. Record Drawings: At project closeout, submit record drawings of installed refrigerant piping and piping products, in accordance with requirements of Division 1 and Division 23.

4. Maintenance Data: Submit maintenance data and parts lists for refrigerant piping materials and products. Include this data, product data, shop drawings and record drawings in maintenance manual; in accordance with requirements of Division 1 and Division 23.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, temperature ratings and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ANSI B31.5 Code for Refrigeration Piping where applicable; base pressure rating on refrigerant piping system maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials that match pipe materials used in refrigerant piping systems. Where more than one type of materials or products are indicated, selection is installer's option.

2.2 BASIC PIPE AND PIPE FITTINGS

A. General: Provide pipes and pipe fittings in accordance with the following listing:

1. Tube Size 3" and Smaller: Copper tube, Type L, hard drawn temper; mark "ACR", ANSI B16.22 wrought copper, solder joint fittings; soldered joints.

2. Brazed Joints: Braze joints using American Welding Society (AWS) classification BCuP-4 for brazing filler metal.

3. Provide precleaned and precharged tubing (line sets) by equipment manufacturer at Contractors discretion.

B. Provide piping specialties complying with Section 23 20 01 - Piping Specialties.

C. Provide supports and anchors complying with Section 23 05 29 –Supports and Anchors.

2.3 SPECIAL REFRIGERANT VALVES

A. Globe and Check Valve:

1. Globe Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300°F temperature rating, 500 psi working pressure.

2. Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless steel spring, 250°F temperature rating, 500 psi working pressure.

3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering globe and check valves which may be incorporated in the work include, but are not limited to, the following: Henry Valve Co.; Parker Hannifin Corp., Refrigeration and Air Cond. Div.; Sporlan Valve Co.

B. Solenoid Valves:

1. Two-way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, teflon valve seat, NEMA 1 solenoid enclosure, 24 volt, 60 Hz, UL listed, ½" conduit adapter, 250°F temperature rating, 400 psi working pressure.

2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering solenoid valves which may be incorporated in the work

include, but are not limited to, the following: Alco Controls Div., Emerson Electric Co.; Automatic Switch Co.; Sporlan Valve Co.;

2.4 REFRIGERANT SPECIALTIES

A. Refrigerant Strainers: Brass shell and end connections, brazed joints, monel screen, 100 mesh, UL listed, 350 psi working pressure.

B. Moisture Liquid Indicators: Forged brass, single port, removable cap, polished optical glass, solder connections, UL listed, 200°F temperature rating, 500 psi working pressure.

C. Refrigerant Filter Dryers: Corrosion resistant steel shell, steel flange ring and spring, wrought copper fittings, ductile iron cover plate with steel cap screws, replaceable filter drier core, 500 psi working pressure.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering refrigeration accessories which may be incorporated in the work include, but are not limited to, the following: Alco Controls Div., Emerson Electric Co.; Henry Valve Company; Parker-Hannifin Corp., Refrigeration & Air Cond. Div.; Sporlan Valve Company

2.5 BASIC VIBRATION CONTROL

A. General: Provide vibration control products complying with Section 23 05 48 "Vibration Isolation", in accordance with the following listing:

1. Isolation hangers
2. Flexible pipe connectors

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which refrigerant piping systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 INSTALLATION OF BASIC IDENTIFICATION

A. General: Install mechanical identification in accordance with Division 23 Basic Mechanical Materials and Methods section "Mechanical Identification."

3.3 INSTALLATION OF REFRIGERANT PIPING

A. General: Install refrigerant piping in accordance with Wisconsin Code Comm 45 and in compliance with equipment manufacturer's recommendations.

B. Install refrigerant piping with ¼" per foot (1%) downward slope in direction of flow for oil return to compressor. Provide oil traps and double risers where indicated and where required to provide oil return.

C. Clean refrigerant piping by swabbing with dry lintless (linen) cloth, followed by refrigerant oil soaked swab. Remove excess oil by swabbing with cloth soaked in high flash point petroleum solvent, squeezed dry.

D. Bleed dry nitrogen through refrigerant piping during brazing operations.

3.4 INSTALLATION OF PIPING SPECIALTIES

A. Install piping specialties in accordance with requirements of Section 23 20 01 -Piping Specialties.

3.5 INSTALLATION OF SUPPORTS AND ANCHORS

A. Install supports and anchors in accordance with requirements of Section 23 05 29 – Supports and Anchors.

3.6 INSTALLATION OF SPECIAL REFRIGERANT VALVES

A. General: Install refrigerant valves where indicated and in accordance with manufacturer's instructions. Remove accessible internal parts before soldering or brazing, replace after joints are completed.

3.7 INSTALLATION OF REFRIGERANT ACCESSORIES

A. Refrigerant Strainers: Install in refrigerant lines as indicated and in accessible location.

B. Moisture Liquid Indicators: Install as indicated on refrigerant liquid lines, in accessible location.

C. Refrigerant Filter Dryers: Install in refrigerant lines as indicated and in accessible location for service.

3.8 EQUIPMENT CONNECTIONS

A. General: Connect refrigerant piping to mechanical equipment as indicated, in accordance with section 23 05 48 – Vibration Isolation, and comply with equipment manufacturer's instructions where not otherwise indicated.

3.9 FIELD QUALITY CONTROL

A. Refrigerant Piping Leak Test: Prior to initial operation, clean and test refrigerant piping in accordance with ANSI B31.5 "Refrigeration Piping." Perform initial test with dry nitrogen, using soap solution to test all joints. Perform final test with 27" vacuum and then pressurize to 200 psig. Tap joints with a rubber mallet and test for leaks using halide torch. System must be entirely leak free.

B. Repair or replace refrigerant piping as required to eliminate leaks and retest as specified to demonstrate compliance.

3.10 DEHYDRATION AND CHARGING SYSTEM

A. Install core in filter dryer after leak test but before evacuation.

B. Evacuate refrigerant system with high vacuum pump to 500 microns Hg.

C. During evacuation apply heat to pockets, elbows and low spots in piping.

D. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system. Test is to be witnessed by owner's representative.

E. Break vacuum with refrigerant gas; allow pressure to build up to 2 psi.

F. Complete charging of system using new filter dryer core in charging line. Provide full operating charge. Turn spent filter dryer core over to Owner.

G. After the system has been in operation one month, replace filter dryer core and turn over spent filter dryer core to Owner.

END SECTION 23 23 00

DIVISION 23 - HVAC
SECTION 23 25 00 - CHEMICAL TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of chemical treatment equipment work required by this section is indicated on drawings and schedules and by requirements of this section.

B. Refer to other Division 23 sections for boilers, piping, specialties, concrete pads and field applied tank insulation, required for installation of chemical treatment equipment; not work of this section.

C. Electrical Work: Provide the following wiring as work of this section, in accordance with requirements of Division 26:

1. Low voltage control wiring between chemical treatment equipment units and remote mounted thermostats and controls.

2. Provide factory mounted and factory wired controls and electrical devices as specified in this section.

D. Refer to Division 26 sections for other electrical wiring including motor starters, disconnects, wires/cables, raceways and other required electrical devices; not work of this section.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, furnished specialties and accessories; and installation and start-up instructions.

B. Maintenance Data: Submit maintenance data and parts lists for each chemical treatment equipment item, including "trouble shooting" maintenance guide. Include this data, product data, shop drawings and wiring diagram in maintenance manual; in accordance with requirements of Division 1.

1.4 OPERATION AND MAINTENANCE DATA

Provide for the services of the manufacturer's trained representative to approve the installation and instruct the user agency in the operation of each system.

Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.5 DESIGN CRITERIA

Recommend a periodic test procedure and chemical treatment program for each system.

Treat the following systems:

- Hot water

Provide the initial chemical treatment for all systems based on a complete system fluid analysis prior to the equipment installation. The initial chemical treatment supply of chemicals for each system shall be adequate for the start-up and testing period, for the time the systems are being operated by the Contractor for temporary heating and cooling, and for one year after start-up of the system.

The chemicals used in the condenser water treatment system shall use only liquid chemicals and shall contain no phosphates or chromates.

Provide electrical devices, motors, wiring and conduit in accordance with the applicable sections of the Electrical Specifications.

MAINTENANCE SERVICE

Furnish service and maintenance of treatment systems for one year from date of substantial completion.

Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.

Provide laboratory and technical assistance services for the warranty period.

Include two hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of the treatment systems. Arrange course at startup of systems.

Provide site inspection of equipment during scheduled shutdown to evaluate success of the treatment program. Make recommendations in writing based on these inspections.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of chemical treatment equipment, of types and capacities required, whose products have been in satisfactory use in similar service not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with chemical treatment equipment work similar to that required for project.

C. Codes and Standards:

1. UL and NEMA Compliance: Provide electric motors and ancillary electrical components which are UL listed and labeled and which comply with NEMA standards.

2. NEC Compliance: Install chemical treatment equipment in accordance with applicable electrical requirements of NFPA 70, "National Electrical Code."

3. ASME Compliance: Comply with applicable requirements of ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Contract chemical treatment with the existing City of Madison chemical treatment provider. Lakeland Chemical – Contact Scott Olson 414-254-9987

2.2 SYSTEM CLEANER

Blend of organic alkaline penetrants, emulsifiers, surfactants and corrosion inhibitors that remove grease and petroleum products from the interior of piping systems. Cleaners that contain trisodium phosphate are specifically **NOT** acceptable.

2.3 SYSTEM INHIBITOR

Scale and corrosion inhibitor consisting of boron nitrite, benzol thiazol, benzotriazole, mercapto-benzo-thiazole, and tolyltrizole silicates.

2.4 ALGAECIDES

Chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quaternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones, all in a liquid format.

2.5 CLOSED WATER SYSTEM TREATMENT

Sequestering agent to reduce deposits and adjust pH: polyphosphate.

Corrosion inhibitors: boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.

Conductivity enhancers: phosphates or phosphonates.

2.6 CLOSED WATER SYSTEM TREATMENT EQUIPMENT

A. General: Provide shot feeders of 5 gallon capacity or otherwise as indicated, constructed of cast iron or steel, for introducing chemicals in hydronic system. Provide funnel and valve on top for loading, drain valve in bottom and recirculating valves on side. Construct for pressure rating of 125 psi.

B. Manufacturer: Subject to compliance with requirements, provide shot feeders of one of the following: Culligan USA; Vulcan Laboratories, Subsidiary of Clow Corp.; York-Shipley, Inc.; or approved equal.

C. Install shot feeders on each hydronic system at pump discharge and elsewhere as indicated. Install in upright position with top of funnel not more than 48" above floor. Install butterfly valve in pump discharge line between recirculating lines. Pipe drain to nearest plumbing drain.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which chemical treatment equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF CHEMICAL TREATMENT EQUIPMENT

A. General: Install chemical treatment equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations

indicated and maintain manufacturer's recommended clearances.

B. System shall include all the chemicals required during the first year of operation and the man-hours required for system monitoring every 30 days. Chemicals shall provide for control caustic and alkaline properties of water as required for the systems.

C. Accessories: Install chemical treatment equipment accessories not installed at factory.

3.3 CLEAN AND TEST AND FILL

A. Clean piping systems with cleaning agent and clear water solution. Concentration of cleaning agent shall be sufficient to raise the M alkalinity to a value of 250 above clear water. Fill entire system purging all air. Provide pipe cleaning and inhibiting agents for initial piping system cleaning and treatment. Circulate cleaning solution for 24 hours or more in accordance with manufacturer's recommendations. Chemical test is to be performed and recorded on report verifying alkalinity. Drain system. Clean and flush entire system with clear water removing all dirt and debris. After flushing remove and clean all strainer screens and baskets.

B. Before covering piping with insulation, fill with clear water venting all air and pressurize to 100 psig. Test for 8 hours. If leakage occurs or pressure drop exceeds 5%, replace and repair as necessary and retest. Do not use chemicals, stop-leak compounds, mastics or other temporary repair methods.

C. After pressure test, add inhibiting agent to hot water systems. Add inhibiting agent to shot feeders to obtain concentration of 700 to 1000 parts per million in the piping system. Chemical test is to be performed and recorded on report verifying concentration.

D. Prepare test report for each piping system showing piping service, test pressure, test period, required repairs if any, retest data, cleaning and sterilization compounds used. Owner's construction supervisor to witness testing and cleaning procedures and provide approval signature on completed form verifying report data. Submit test report for approval.

3.4 FIELD QUALITY CONTROL

A. General: Start-up chemical treatment equipment, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

3.5 CLOSEOUT PROCEDURES

A. Training: Provide services of manufacturer's technical representative for a 4-hour period to instruct owner's personnel in operation and maintenance of chemical treatment equipment. Schedule training with owner, provide at least 7-day notice to contractor and engineer of training date.

END SECTION 23 25 00

DIVISION 23 - HVAC
SECTION 23 31 13 – LOW AND MEDIUM PRESSURE DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. 23 05 29 - Supports and Anchors

C. 23 33 00 – Duct Accessories

1.2 DESCRIPTION OF WORK

A. Extent of low-pressure ductwork is indicated by the requirements of this section. Low pressure ductwork is hereby defined as ductwork subjected to velocities of 2500 fpm or less and operating pressure of 2" w.g. or less, positive or negative. Types of low-pressure ductwork required for project include the following:

1. Supply air ductwork downstream of VAV terminals.
2. Power ventilator exhaust systems.
3. Return air ductwork.
4. Transfer air systems.
5. Kitchen grease exhaust systems

B. Extent of medium pressure ductwork is indicated by the requirements of this section. Medium pressure ductwork is hereby defined as ductwork subjected to velocities of 3500 fpm or less and operating pressure of 4" or less, positive or negative.

Types of medium pressure ductwork required for project include the following:

1. Supply air ductwork upstream of VAV terminals (branches and mains).

C. Refer to Section 23 07 00 for external insulation required in conjunction with medium and low pressure ductwork; not work of this section.

1.3 SUBMITTALS

A. Product Data:

1. Submit schedule of materials, proposed joints, reinforcement and sealants to be used for shop fabricated ductwork use for work of this section.

2. Submit manufacturer's specifications on manufactured products and factory fabricated ductwork, used for work of this section.

B. Record Drawings: At project closeout submit record drawings of installed ductwork, duct accessories and outlets and inlets; in accordance with requirements of Division 1.

1.4 QUALITY ASSURANCE

A. SMACNA Standards: Comply with SMACNA "Duct Construction Standards", latest editions, for fabrication, installation, and testing of medium and low pressure ductwork.

B. NFPA Compliance: Comply with ANSI/NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and ANSI/NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect shop fabricated and factory fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping. Lined ducts shall not be stored outside.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, and seam marks, roller marks, oil canning, stains and discolorations and other imperfections including those which would impair painting. Provide paint grip finish.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 653, lock forming quality, galvanized coating 1.20 ounces per square foot or greater, both sides, G90 per ASTM A90; MINIMUM 26 GAGE; mill phosphatized for exposed locations. Provide paint grip finish on exterior ductwork. Where welded black steel sheet is indicated, use first quality, soft steel sheet capable of welding or double seaming without fracture.

C. Kitchen Grease Exhaust Ductwork: Where ductwork is located in concealed locations, fabricate using minimum 16 gauge black steel or minimum 18 gauge stainless steel with all joints welded liquid tight or prefabricated grease duct with Underwriters Laboratory, Inc listing and aluminized steel shell. Where ductwork is exposed, use 18 gauge or heavier stainless steel with a number 3 finish, with all joints welded liquid tight or prefabricated Underwriters Laboratory, Inc listed duct with stainless steel shell. Grind and polish all welded joints and seams to a number 3 finish.

D. Aluminum Ductwork: ANSI/ASTM B209 aluminum sheet, alloy 3003H-14 double lockforming quality.

E. Flexible Ductwork: Factory fabricated flexible ductwork may be used in lieu of above sheet metal in concealed accessible ceiling spaces for 4' maximum upstream of supply diffusers only. Flexible duct shall be factory made insulated round air duct with a reinforced outer vapor barrier jacket enclosing 1-1/2" thick fiberglass insulation wrapped around a continuous vapor barrier film reinforced with a steel wire helix. Duct shall meet 25/50 flame spread/smoke developed rating and have a "K" factor of .30/inch at 75°F. Duct shall bear UL Class I air duct label as tested by UL 181. Duct shall be rated for 4" w.g. static pressure and 3000-FPM velocity.

F. Acoustic Lined Ductwork: Apply a 1" thick insulation sound lining where indicated on the

drawings. Liner material shall be glass fiber material with mat face. Maximum thermal conductivity of 0.26 Btu-inch per hour-square foot – degree F at 75°F mean temperature, 2.0 PCF density, and air friction correction factor shall not exceed 1.15 at 2000 FPM air velocity. Lining adhesive to suitable for air velocities to 5000 FPM and temperatures to 250°F. Knauf Liner EM, Owens Corning Aeroflex, Schuller Linacoustic, Certainteed Ultralite, or equal.

2.2 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Duct Sealant: Nonhardening, nonmigrating mastic or liquid elastic sealant (type applicable for fabrication/installation detail) as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.

C. Duct Cement: Nonhardening migrating mastic or liquid neoprene based cement (type applicable for fabrication/installation detail) as compounded and recommended by manufacturer specifically for cementing fitting components or longitudinal seams in ductwork.

D. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

2.3 FABRICATION

A. Shop-fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards." Galvanized ducts shall be used unless otherwise indicated.

B. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with centerline radius equal to associated duct width. Fabricate turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers. Use high efficiency 45 degree take-offs for branch ducts. Use bell mouth take-offs at plenum connections.

C. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Section 23 33 00 "Duct Accessories" for accessory requirements.

D. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive and fasten with mechanical fasteners. Fasten perforated metal liner on supply ducts where indicated, and fasten solid metal liner a minimum of 12" upstream and 36" downstream of humidifier manifolds.

2.4 FACTORY FABRICATED DUCTWORK

A. General: At installer's option, provide factory-fabricated duct and fittings, in lieu of shop fabricated duct and fittings.

B. Materials and gages as specified in section 2.1.

C. Elbows: One-piece construction for 90° and 45° elbows 14" and smaller. Provide multiple core construction for larger diameters with standing seam circumferential joint.

D. Divided Flow Fittings: 90° tees, constructed with saddle tap spot welded and bonded to duct fitting body.

E. Manufacturer: Subject to compliance with requirements for application, provide factory fabricated ductwork of one of the following: United Sheet Metal Div., United McGill Corp.; Semco Mfg., Inc.; Steelcraft Corp.; or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUCTWORK

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve airtight and noiseless (no objectionable noise) systems capable of performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type that will hold ducts true to shape and to prevent buckling, oil-canning, and tinning.

B. Rectangular medium pressure ductwork greater than 3 square foot area, shall use a transverse joint system as manufactured by Ductmate, TDC, TDF, or approved equal. Duct to be flanged, gasketed and sealed.

C. Seal ductwork after installation to SMACNA Class "B" for low pressure and Class "A" for medium pressure systems, as described in SMACNA "Duct Standards". Spiral round standing seams do not require sealing.

D. Install concrete inserts or mechanical fasteners in concrete construction for support of ductwork. Install mechanical fasteners on structural steel prior to structural fireproofing.

E. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces conceal ductwork from view by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

F. Provide lined ductwork for:

1. Transfer ductwork as detailed on drawings.
2. Rectangular supply ductwork where indicated on drawings.

G. Use aluminum sheet ducts for all branch exhaust ducts serving shower rooms, high humidity areas, similar wet spaces, and other ducts as indicated on the Drawings. Seal all joints, latitudinal and longitudinal with silicone sealant. Pitch aluminum branch ducts serving wet spaces to drain back to inlet grilles.

H. Grease Duct Installation:

1. Where welded joints are used with black steel duct, coat all external welded

joints and seams with high temperature paint. Grind and polish to #3 finish all exposed stainless steel joints and seams.

2. Apply bracing and reinforcement to the outside of the duct to prevent breathing, rattling, vibration or sagging of duct.

3. Factory-built grease duct assemblies shall be listed and labeled for use as commercial kitchen grease duct assemblies in accordance with UL approvals. Such assemblies shall be installed in accordance with the listing and manufacturers' installation instructions. Complete installation shall follow code requirements for pitch, access doors etc.

4. Install without forming dips, sag or undrain able traps which might collect residue by supporting at not greater than 5 foot intervals; fasteners at hangers shall not penetrate the duct. Do not use sheet metal screws on supports; use bolted, riveted or welded connections. Where ductwork is listed, install in accordance with listing.

5. Construct grease tight access doors with high temperature gasket to cover the entire door plate. Door plate shall be of the same material and thickness as the duct and as large as possible, up to maximum 24 inches in any dimension or provide manufactured UL approved doors. Locate on side of duct at intervals as required by current code for ease of inspection and cleaning and at each change in direction, and where shown on plans, including risers, and not less than 1-1/2 inches from the bottom of the duct.

6. Fire protection enclosure or wrap shall be easily removable and replaceable at each duct access door and clean out or provide rated manufactured access doors approved for the fireproofing application.

7. Pitch horizontal ducts at 1/8 inch per foot to hood and/or drainable traps in the direction of air flow.

8. Provide residue trap at the base of each vertical rise with provisions for cleanout to access the bottom of the trap for cleaning.

I. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and their electrical equipment clear spaces and enclosures. Where ductwork serves the electrical space, all ductwork shall have a watertight drip pan with soldered joints and shall have a 1" bottom drain every 10' of pan length with a 1" galvanized steel line routed to a floor drain. Pan shall equal duct width plus 6" (3" beyond each side) and shall be 2" deep.

J. Where ducts pass through an exposed interior partition or wall conceal space between construction opening and duct or duct plus insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2".

K. Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

L. Support ductwork in manner complying with SMACNA hangers and supports section.

M. Louvers:

1. Provide 2" rigid fiberglass insulation sandwiched between two layers of

galvanized sheet metal on back side of unused portions of louver. Paint louver side of close off sheet flat black.

2. Pitch bottom of duct and or plenum to drain out bottom of louver.

3. Where pitching of duct or plenum to drain out louver is not possible, provide sloped drain pans with soldered seams at bottom plenum and provide a 1" trapped drain pipe extending to floor drain or building exterior.

N. All medium pressure ductwork systems shall be leak tested according to SMACNA "HVAC Air Duct Leakage Test Manual - 1st Edition-1985." Test pressure to equal 4" w.g., Leakage class 6 for rectangular and 3 for round. Conduct test on 90% of the main duct and 10% of the branch ducts closest to the fan. Test report shall be submitted to Architect/Engineer.

3.2 CLEANING

A. Clean ductwork internally, unit by unit as it is installed of dust and debris. Clean external surfaces of foreign substances that might cause corrosive deterioration of metal or where ductwork is to be painted, might interfere with painting or cause paint deterioration.

3.3 BALANCING

A. Refer to Section 23 05 93 "Testing, Adjusting and Balancing" for air distribution balancing of medium and low-pressure ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END SECTION 23 31 13

DIVISION 23 - HVAC
SECTION 23 33 00 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. 23 31 13 – Low and Medium Pressure Ductwork

1.2 DESCRIPTION OF WORK

A. Extent of duct accessories work is indicated on drawings and in schedules and by requirements of this section. Equipment included herein includes the following:

dampers	fire dampers
turning vanes	duct hardware
duct access doors	kitchen grease duct access doors
flashings	smoke detectors

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications for each type of duct accessory including dimensions, capacities, materials of construction and installation instructions.

B. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory; include this data in Maintenance Manual.

1.4 QUALITY ASSURANCE

A. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) "HVAC Duct Construction Standards, Metal and Flexible-Second Edition, 1995"

B. Industry Standards: Comply with American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE) recommendations pertaining to construction of duct accessories, except as otherwise indicated.

C. UL Compliance: Construct, test and label fire dampers in accordance with Underwriters Laboratories (UL) Standard 555 "Fire Dampers and Ceiling Dampers." Flexible connections and similar materials to be fire retardant and UL 214 listed.

D. NFPA Compliance: Comply with applicable provisions of ANSI/NFPA 90A "Air Conditioning and Ventilating Systems" pertaining to installation of duct accessories.

PART 2 - PRODUCTS

2.1 DAMPERS

A. Volume Dampers: Provide dampers constructed in accordance with SMACNA Fig. 2-12, Fig. 2-13, and associated notes. Provide continuous rod on single blade dampers as

indicated in fig. 2-12. All volume dampers shall be provided with lockable quadrants and stand-off brackets on insulated ducts. Dampers shall be constructed of same material as the ductwork served i.e.; galvanized, aluminum, etc.

B. Control Dampers: Control dampers are furnished by the Temperature Control Contractor. Reference Section 23 90 00.

C. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following: Air Balance, Inc.; Airguide Corp.; Air Balance; Arrow Louver and Damper; Greenheck, Penn Ventilator Co.; Ruskin Manufacturing Co.; Vent Products; Sheet Metal Connectors or approved equal.

2.2 FIRE DAMPERS

A. Furnish and install, at locations shown on plans, fire dampers of the interlocking blade curtain type, or multi-blade type, constructed and dynamically tested in accordance with UL Safety Standard 555. Constructed of same material as the ductwork served. All fire dampers shall have a 1-1/2 hour fire protection rating, unless noted otherwise. Provide 165°F fusible link and a UL label in accordance with established UL labeling procedures. Damper manufacturer's literature submitted for approval prior to installation shall include comprehensive performance data developed from testing in accordance with AMCA Standard 500 and shall illustrate pressure drops for all sizes of dampers required at all anticipated air flow rates. Provide style "B" dampers, with open blades out of the airstream, unless noted otherwise, to provide free area opening equal to duct size. Multiple section curtain type dampers shall be provided with a UL rated mullion system or shall be multi blade type. Multi-blade fire dampers shall have maximum 0.17" wg pressure drop based on 24"x24" damper at 2000fpm. Fire dampers shall be equipped for vertical or horizontal installation as required by the location shown.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire dampers which may be incorporated in the work include, but are not limited to, the following: Air Balance, Inc.; American Warming & Ventilating, Inc.; Arrow Louver and Damper Corporation; Louvers and Dampers; Greenheck; Prefco Products, Inc.; Ruskin Manufacturing Company; or approved equal.

2.3 TURNING VANES

A. Manufactured Turning Vanes: Provide air foil turning vanes constructed of 1-1/2" wide curved blades set at 1-1/2" o.c., supported with bars perpendicular to blades set at 2" o.c., and set into side strips suitable for mounting in medium pressure ducts, or for ducts 18" or wider. Provide single width type turning vanes in square elbows less than 18" wide in low pressure ducts. Constructed of same material as the ductwork served.

2.4 DUCT HARDWARE

A. General: Provide duct hardware manufactured by one manufacturer for all items on project for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.

2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct hardware which may be incorporated in the work include, but are not limited to, the following: Ventfabrics, Inc.; Young Regulator Company; or approved equal.

2.5 DUCT ACCESS DOORS

A. General: Provide where indicated and where required for service or cleaning of duct enclosed equipment. Examples include fire and smoke dampers, motorized damper, and control valves & actuators. Provide duct access doors of size required for intended service, 12" x 3/4 duct dimension minimum or 18" x 24" where head and shoulder access is required.

B. Construction: Construct of same or greater gage as ductwork served and of same material i.e.; galvanized, stainless steel or PVC. Provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged other side with one handle type latch for doors 12" high and smaller, two handle type latches for larger doors.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct access doors which may be incorporated in the work include, but are not limited to, the following: Air Balance, Inc.; Duro Dyne Corporation; Ruskin Manufacturing Company; Ventfabrics, Inc.; Ward Industries, Inc.

2.6 FLASHINGS

A. Provide flashing to completely weatherproof connection of ductwork to louvers. Flashing to be constructed of material similar to louver material.

B. Flashing and counterflashing for roof curbs will be provided by others.

C. Flashing and curbs for duct and pipe penetrations of roof assemblies to be in accordance with details.

2.7 SMOKE DETECTORS

A. Smoke detectors are furnished and installed by the Electrical Contractor.

2.8 KITCHEN GREASE DUCT ACCESS DOORS

A. General: Where indicated and where required per code for cleaning the interior of the duct. Examples include at each change in direction, at each floor penetration and every 20 feet in straight runs. Provide duct access doors 12" x 3/4 duct dimension but no smaller than 12"x 12" minimum size.

B. Construction: Assembly shall meet NFPA-96 requirements and constructed of 14 GA black iron or 16 GA stainless steel to match duct construction. Provide 2"x 2"x 1/8" angle neck extension with ½" protrusion into duct on doors mounted on bottom of duct. Stud bolts to with wing nuts to secure access door and fireproofing wrap shall be minimum 3/8" diameter and 6" on center. Provide high temperature gasket all around perimeter of opening between door and flange.

C. Factory manufactured UL rated grease duct doors with appropriate optional kits for fire proofing system are acceptable.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers

offering duct access doors which may be incorporated in the work include, but are not limited to, the following: Kees; Flame Gard; Ductmate Industries

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which duct accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF ACCESSORIES

A. Install duct accessories in accordance with manufacturer's installation instructions with applicable portions of details of construction as shown in SMACNA standards and in accordance with recognized industry practices to ensure that products serve intended function.

B. Fire dampers shall be installed in wall and floor openings utilizing steel sleeves, angles, other materials, and practices required to provide an installation equivalent to that utilized by the manufacturer when dampers were tested at UL. Installation shall be in accordance with the damper manufacturer's instructions, NFPA 90A and appropriate SMACNA Standards.

C. Connect outside air intake duct to the louver, sealing all connections air and water tight. Provide screen on inside of active louver area where none is provided with louvers. Install insulated metal panel on unused portion of louver.

D. Install turning vanes in square or rectangular 90° elbows and tees, and in elbows and tees with centerline radius less than one duct width and elsewhere as indicated.

E. Install access doors adjacent to damper operators or motors, fire dampers, damper quadrants, plenums, filters, AFCV's, coils, fan motors, valves, traps, bearings, inlet and outlet of fan in air handling units, oiling devices, and other devices which require attention and are not accessible through other means and elsewhere as indicated.

F. Provide balancing damper upstream of each outlet and inlet. Damper shall be at take off, or as far upstream as possible to minimize air dampering noise.

G. Coordinate with other work including ductwork as necessary to interface installation of duct accessories properly with other work.

H. Install control dampers in ductwork as required by Temperature Control Section 23 90 00.

I. Install kitchen grease duct access doors per NFPA-96, access door manufacturers' instructions and fire wrap manufacturers ESR installation instructions for proper access. Provide continuous welds where required for liquid tight construction. Extend throat of access door into duct where mounted on bottom of duct to keep grease from collecting on access door.

J. Field Quality Control: Operate installed duct accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories as required to obtain proper operation and leak-proof performance.

END SECTION 23 33 00

DIVISION 23 - HVAC
SECTION 23 34 23 - POWER AND GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of power ventilator work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of power ventilators specified in this section include the following:

1. Power Ventilators:

a. Centrifugal roof ventilators

2. Ceiling Ventilators:

a. Ceiling exhausters

3. Gravity Ventilators:

a. Hooded gravity ventilators

4. Prefabricated roof curbs.

C. Refer to Division 26 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on fan motor. Include starters, disconnects and required electrical devices, except where specified as furnished or factory installed, by manufacturer.

2. Interlock wiring between fan units; and between fans and field installed control devices.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for power and gravity ventilators, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions. Single point operating curves are **NOT** acceptable.

B. Shop Drawings: Submit assembly type shop drawings showing unit dimensions, construction details, methods of assembly of components, and field connection detail.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to power ventilators. Submit manufacturer's ladder type wiring diagrams for interlock and

control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.

D. Maintenance Data: Submit maintenance data and parts list of each type of power and gravity ventilator, accessory, and control. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

1.4 QUALITY ASSURANCE

A. Provide equipment with AMCA Certified Ratings and UL listed and labeled electrical components. Sound rate in accordance with AMCA 300.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver ventilation equipment with factory installed shipping skids and lifting lugs; pack components in factory fabricated protective containers.

B. Handle ventilation equipment carefully. Do not install damaged components; replace and return damaged components to manufacturer.

C. Store ventilation equipment in clean dry place and protect from weather and construction traffic. Comply with manufacturer's rigging and installation instructions.

PART 2 - PRODUCTS

2.1 POWER VENTILATORS

A. General: Except as otherwise indicated, provide standard prefabricated power ventilator units of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation.

B. Centrifugal Roof Ventilators: Provide centrifugal roof type, curb mounted, power ventilators of type, size, and capacity as scheduled, and as specified herein.

1. Type: Centrifugal backward inclined fan wheel, direct driven as scheduled. Provide with spun aluminum weatherproof housings. Provide square base to suit roof curb. Provide permanently lubricated, capacitor-start, induction-run type motor. Housing design to be as scheduled: Downblast or Upblast type. Fan shall bear AMCA certified rating seal for sound and air performance.

2. Electrical: Provide factory-wired nonfusible type disconnect switch at motor in fan housing. Provide thermal overload protection in fan motor. Provide conduit chase within unit for electrical connection. Provide solid state fan speed controller for each direct drive fan as scheduled.

3. Grease-Laden Exhaust: Where scheduled, in addition to above, provide centrifugal roof ventilators conforming to UL 762 (Power Ventilator for Restaurant Appliances). Include a factory provided fan housing drain with grease trap.

4. Bird Screens: Provide removable bird screens, ½" mesh, 16-gage aluminum or brass wire.

5. Provide minimum 18" high roof curb of size to match unit dimensions constructed of galvanized metal with 1 ½" thick fiberglass insulation and wood nailing block around entire perimeter.

6. Dampers: Motor-operated dampers at inlets, by Temperature Control, not work of this Section.

7. Manufacturer: Subject to compliance with requirements, provide centrifugal roof ventilators of one of the following: Acme; Aerovent; Carnes Co; Cook (Loren) Co.; Greenheck; JennFan; Penn Ventilator; Power Line; Soler & Palau or approved equals.

2.2 CEILING VENTILATORS

A. Ceiling Exhausters:

1. Provide ceiling exhausters, designed for ceiling or wall mounting, of type, size and capacity as scheduled.

2. Provide AMCA Certified Rating Seal.

3. Type: Provide galvanized steel housing lined with acoustical insulation, adaptable for ceiling installation. Provide impeller type wheel fan wheels mounted on motor shaft with fan shrouds, all removable for service. Provide integral backdraft damper fan discharge.

4. Grille: Provide white finished grille with thumbscrew attachment to fan housing.

5. Motor: Provide permanent split-capacitor motor, permanently lubricate, with grounded cord and plug.

6. Discharge: Provide metal roof or wall cap with back draft damper and bird screen as scheduled or otherwise indicated on Drawings. Rust-resistant finish or as indicated on Drawings.

7. Electrical: Provide junction box for electrical connection on housing, and receptacle for motor plug-in.

   Furnish remote fan speed control, solid state, capable of controlling fan speed from full speed to approximately half speed, where scheduled.

8. Manufacturer: Subject to compliance with requirements, provide impeller type ceiling exhausters of one of the following: Acme; Air Control Products; Broan; Carnes; Cook (Loren) Co.; Dayton Electric; ILG Industries; JennFan; Power Line; Soler & Palau or approved equals.

2.3 GRAVITY VENTILATORS

A. General: Except as otherwise indicated, provide standard prefabricated gravity ventilator units of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation.

B. Hooded Gravity Ventilators: Provide gravity ventilators, hooded type, curb mounted, of size, type and capacity as scheduled, and as specified herein.

1. Type: Stationary, natural draft type. Provide weatherproof housings to match power ventilators in material and finish. Provide square or rectangular base and roof curb. Provide paint grip finish.

2. Insect Screens; Provide removable bird screens, ½" mesh, 16 gage aluminum or brass wire.

3. Hood Insulation: Provide insulation on interior of hood to prevent condensation.

4. Provide minimum 18" high roof curb of size to match unit dimensions constructed of galvanized metal with 1 ½" thick fiberglass insulation and wood nailing block around entire perimeter.

5. Dampers: Provide louvered dampers with linkage below roof. Refer to Division 23 90 00 automatic temperature control sections for damper motor and control sequence; not work of this section.

6. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

7. Manufacturer: Subject to compliance with requirements, provide products of one of the following: Acme Engineering; Aerovent; Carnes; Cook (Loren) Co.; Greenheck; Power Line; or approved equals.

2.4 PREFABRICATED ROOF CURBS

A. General: Provide manufacturer's standard shop fabricated units, modified if necessary to comply with requirements.

B. Fabricate structural framing for units of structural quality sheet steel (ASTM A 570, Grade 40), formed to profiles indicated or, if not indicated, to manufacturer's standard profiles for coordination with roofing, insulation and deck construction. Include 45° cant strips and deck flanges with offsets to accommodate roof insulation. Weld corners and seams to form watertight units. Delete 45° cant strips where not required or acceptable with roofing type. Coordinate with roofing contractor.

1. Fabricate units from zinc coated steel, ASTM A 446, Grade C, designation G90 hot-dip coating, mill phosphatized.

C. Reinforce continuous runs of over 3'-0" length by inserting welded stiffeners of heavy gage with flanges as required to provide sufficient rigidity and strength to withstand maximum lateral forces in addition to superimposed vertical loads.

D. Sloping Roof Decks: For deck slopes of ¼" per foot and more, fabricate support units for form level top edge.

E. Gage and Height: Fabricate units of zinc coated steel, gage and to height above roof surface as indicated. Where gage or height are not indicated, fabricate units of 18-gage steel, and nominal height of 12" above the top of the roof.

F. Provide pressure treated wood nailer, not less than 1-1/2" thick and of width indicated, but not less than width of support wall assembly. Anchor nailer securely to top of metal frame unit.

G. Fabricate exterior support profile to receive insulation of thickness indicated or, if not indicated, of 1" thickness.

H. Insulate units inside structural support wall with rigid glass fiber insulation board of approximately 3-lb. density and 1-1/2" minimum thickness, except as otherwise indicated.

I. Provide support liners where shown, formed of 22 gage galvanized sheet metal, mill phosphatized, flanged at lower edges.

1. Extend support liners through deck construction to coordinate with ductwork below as indicated.

2. Use perforated metal for support liners, with approximately 1000, 3/32" diameter holes per sq. ft., to provide sound absorbing surfaces.

3. Provide sound insulation insert for curbs so indicated. Construct of 1" thick rigid fiberglass panels secured in galvanized steel framework, with rounded edges to minimize airflow resistance.

J. Metal Deck Reinforcement: Where indicated as integral part of support units. Provide channel shaped metal deck closure strips to reinforce opening through metal decking. Fabricate strips from 14-gage metal to match metal and finish of curb units, except as otherwise indicated.

K. Manufacturer: Subject to compliance with requirements, provide prefabricated roof curbs of one of the following: Custom Curb; Pate; S & L Manufacturing; ThyCurb; or approved equals.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which power ventilators are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF POWER AND GRAVITY VENTILATORS

A. General: Except as otherwise indicated or specified, install ventilators in accordance with manufacturer's installation instructions and recognized industry practices to insure that ventilators serve their intended function.

B. Coordinate ventilator work with work of roofing, and ceilings, as necessary for proper interfacing.

C. Ductwork: Refer to Section 23 31 13 "Medium and Low Pressure Ductwork". Connect ducts to ventilators in accordance with manufacturer's installation instructions.

1. Provide access door in duct below ventilator to service damper.

2. Solder bottom joints and up 2" of side joints of duct under roof ventilator to retain any moisture entering ventilator.

D. Roof Curbs: Coordinate with General Contractor. Not work of this Section.

E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Verify proper rotation direction of fan

wheels. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

F. Remove shipping bolts and temporary supports within ventilators. Attach units securely to roof curbs with galvanized or aluminum fasteners.

3.3 FIELD QUALITY CONTROL

A. Testing: After installation of ventilators has been completed, test each ventilator to demonstrate proper operation of units at performance requirements specified. When possible, field-correct malfunctioning units, then retest to demonstrate compliance. Replace units that cannot be satisfactorily corrected.

3.4 ADJUSTING AND CLEANING

A. Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch up paint.

END SECTION 23 34 23

DIVISION 23 - HVAC
SECTION 23 36 16 – HYDRONIC TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of heating terminal work is indicated by drawings and schedules. Heating terminals included herein are as follows:

booster (reheat) coils	unit heaters
VAV terminals (VAV)	cabinet unit heaters
fin-tube and baseboard	

B. Refer to Division 26 sections for electrical wiring work required in conjunction with heating terminals; not work of this section.

C. Refer to other Division 23 sections for equipment, ductwork and accessories required in conjunction with heating terminals.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data on heating terminals, including capacities, materials of construction, ratings, weights, wiring diagrams, and appropriate identification for all equipment in this section. Include color selection chart where applicable.

B. Shop Drawings: Submit assembly type shop drawings showing unit dimensions, service clearance requirements, installation and field connection details.

C. Maintenance Data: Submit maintenance instructions, including cleaning instructions and spare parts lists. Include this data in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of heating terminal units, of types, ratings and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: Qualified with at least 3 years of successful installation experience on projects with electrical heating terminal installation work similar to that required for project.

C. Codes and Standards:

1. ARI 210 Standard for Unitary Air-Conditioning Equipment
2. ARI 410 Standard for Forced-Circulation Air-Cooling and Air-Heating Coils
3. CS 140
4. NEC: Comply with applicable heating terminal installation requirements pertaining to installation of space heating equipment and appliances.

5. NFPA 90A: Pertaining to installation of A-C systems.
6. SMACNA: "Ducted Electric Heat Guide for Air Handling Systems."
7. I=B=R: Test and rate convectors and finned tube radiation in accordance with I=B=R, provide published ratings bearing emblem I=B=R.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver heating terminals in factory fabricated type containers. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store heating terminals in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 FIN-TUBE AND BASEBOARD RADIATION

A. Acceptable Manufacturers: AirTherm; Slant/Fin; Standard Radiation; Sterling; Trane; Vulcan; or approved equal.

B. Construct heating elements of steel fin on steel tube or aluminum fin on copper tube. Provide wall mounted support cradles that allow expansion of heating element without noise.

C. Enclosures: Flat top with die formed grilles. Constructed with removable front panels of 18-gauge steel, 20 gauge steel back panels, and furnished with a baked enamel finish in one of the manufacturer's standard colors, selected by Architect. Submit color chart. Provide a dirt gasket for mounting between back panel and wall.

D. Provide accessories such as inside and outside corners and end caps where required for the complete installation. Where wall-to-wall installations are indicated on plans, provide enclosure extensions or field modification of enclosure to conform to actual room dimensions.

E. Provide access doors at all valves, traps, and vents.

2.2 BOOSTER (REHEAT) COILS:

A. Acceptable Manufacturers: Carrier; Singer; Trane; McQuay; Marlo; Bohn; or approved equal.

B. Construct coils of copper tubes and aluminum fins in a serpentine arrangement with piping connections on the same end. Provide galvanized steel casing, end supports, top and bottom channels to allowance for expansion of finned tube section. Factory test coils at 200 psig.

C. Headers may be cast iron with tubes expanded into the header, steel pipe with tubes brazed to the header, or seamless copper with tubes brazed to the header.

D. Frames to be flanged for a gasketed connection to adjacent ductwork or constructed for slip and drive connection to the ductwork.

2.3 UNIT HEATERS

A. Acceptable Manufacturers: Modine; Sterling; McQuay; Trane; or approved equal.

B. Construct casing of 18-gauge steel with baked enamel finish and heating elements of copper tubing with aluminum fins. Use aluminum fan blades, balanced for quiet operation. Provide safety guard for fan/drive assembly. Test coils units at 200 psig.

C. Furnish adjustable horizontal and vertical discharge louvers for units with horizontal discharge. Provide an adjustable cone diffuser for projection units with vertical discharge.

D. Furnish motors with characteristics as scheduled. Single phase, 120-volt motors to be permanently lubricated and provided with thermal overload protection. Provide integral disconnect.

E. Temperature Control contractor to provide wall mounted thermostat.

2.4 CABINET UNIT HEATERS

A. Acceptable Manufacturers: American Air Filter; Sterling; McQuay; Trane; or approved equal.

B. Construct vertical unit casings with 16-gauge steel front panels and minimum 18 gauge steel end and side panels. Horizontal units located in concealed spaces or mounted in ceiling to have minimum 18-gauge front, end, and side panels.

C. Furnish exposed cabinets in baked enamel finish in one of the manufacturer's standard colors, selected by the Architect. Submit color chart.

D. Furnish ceiling mounted units with a hinged front panel to allow access to all internal components.

E. Construct heating elements of copper tubes with aluminum fins, tested at 200 psig.

F. Use centrifugal type fans, statically and dynamically balanced to operate without objectionable noise and vibration.

G. Motors to be 120-volt, single phase, permanently lubricated, with thermal overload protection and disconnect switch at unit.

H. Furnish each unit with filter rack and 1", 25% efficient panel filters.

I. Temperature Control contractor to provide wall mounted thermostat for inverted flow cabinet unit heaters. Integral thermostat for all other units.

2.5 VARIABLE AIR VOLUME TERMINALS (VAV)

A. Acceptable Manufacturers: Anemostat; Carrier; Krueger; Titus; Trane; Envirotech; Johnson Controls or approved equal.

B. VAV Control Units: Units shall be pressure independent, completely factory assembled, consisting of an insulated plenum with air inlet and outlet collars, multipoint flow probe, air volume damper, electronic controller, hot water booster coil (where scheduled) and removable access panel.

C. Casing: Unit casing shall be galvanized sheet steel lined with minimum ½" of 1-1/2 lb./cu. ft. density thermal/acoustic glass fiber insulation not to exceed NFPA 90A smoke and flame spread rating recommendations and to meet UL 181 anti-erosion requirements. Secure lining to prevent de-lamination or sagging. Provide sound attenuator or lined duct

section downstream of box when needed to comply with scheduled NC ratings.

D. Identification: Provide label on each unit indicating manufacturer, model number, cfm range, and plan tag number.

E. Air Dampers: Construct of materials that cannot corrode, do not require lubrication nor periodic servicing. Provide mechanism to vary air volume through damper from minimum to maximum in response to signal from the BAS. Damper leakage not to exceed 2% at 3" wg inlet static pressure.

F. Flow Sensor: The velocity probe shall consist of a multiple point averaging flow sensor with integral flow taps and calibration chart for field balancing.

G. Valve Actuator: Actuator shall be furnished and installed by Temperature Control contractor. Electronic actuator shall include 24-volt motor providing forward, null, and reverse operation. Electronic pressure-independent control shall have heating and cooling setpoints adjustable from the BAS and at the terminal unit.

H. The air pressure drop through the units shall not exceed scheduled values. The unit manufacturer shall furnish certified sound data for both casing radiated and discharge sound levels as tested in an ADC certified laboratory in strict accordance with ARI 880-98 Test Standard and shall include 2nd through 7th octave band data for all unit sizes. Both discharge and radiated NC levels shall be based on a 10dB sound absorption as determined by subtracting the highest point on the power level curve. Sound performance based on other standards or methods will not be accepted. Discharge and radiated NC levels shall not exceed NC 25 at 1.0" inlet pressure.

I. Room temperature controls shall be furnished by the Temperature Control Contractor.

J. See schedule for booster coil requirements. Provide as specified for booster coils.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which the outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected. Coordinate location of units with other trades to assure correct recess size for recessed units.

3.2 INSTALLATION OF TERMINAL UNITS

A. Install heating terminals as indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices to ensure that heating terminal equipment fulfills requirements. Comply with applicable installation requirements of NEC and NECA's "Standard of Installation."

B. Install branch water piping to each unit with a minimum of three elbows to allow for expansion and contraction of the piping system.

C. Clean dust and debris from each heating terminal as it is installed to ensure cleanliness. After installation, provide protective covers to prevent accumulation of dirt on units during balance of construction.

D. Comb out damaged fins where bent or crushed before covering elements with enclosures. Touch up scratched or marred heating terminal enclosure surfaces to match original finishes.

3.3 BOOSTER COILS

A. Comb bent or crushed fins and clean dust and debris from each coil before enclosing coils in ductwork. Pitch coil casings in accordance with manufacturer's instructions. Install a drain valve on the coil side of the shutoff valves for each coil.

B. Pipe coils with multiple rows for counter flow arrangement.

C. Provide access panels upstream and downstream of booster coil for inspection and servicing.

3.4 UNIT HEATERS

A. Suspend units from building structure and install vibration isolation. Supporting from piping systems will not be accepted.

B. Install units in locations indicated on the drawings and as detailed. Install unions for removal of control valves and terminal units.

3.5 CABINET UNIT HEATERS

A. Install units in locations indicated on the drawings and as detailed. Install unions for removal of control valves and terminal units. Install air filters.

3.6 FIN TUBE AND BASEBOARD RADIATION

A. Install dirt guard gasket to mounting strip or caulk along top of mounting strip.

B. Install units in locations indicated on the drawings and as detailed. Install unions for removal of control valves and terminal units.

3.7 VAV terminals

A. General: Furnish air volume terminals as indicated on the project drawings. Units shall be installed as indicated and in accordance with the manufacturer's installation instructions.

B. Provide access panel for inspection and servicing air valve and flow taps.

C. Provide access panels upstream and downstream of booster coil for inspection and servicing.

D. Install units in locations indicated on the drawings and as detailed. Install unions for removal of control valves and terminal units.

E. Repair or replace terminals and duct connections as required to eliminate leaks.

F. Support units from building structural independent of associated ductwork. Maintain sufficient clearance for normal service and maintenance, but in no case less than recommended by manufacturer.

3.8 ADJUSTMENT AND CLEANING OF TERMINAL UNITS

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.

B. Retouch any marred or scratched surfaces of factory-finished cabinets using finish materials furnished by manufacturer.

C. Install new filter for terminals used at any time during construction.

D. Testing, adjusting and balancing is specified in other Division 23 sections; not work of this section.

END SECTION 23 36 16

DIVISION 23 - HVAC
SECTION 23 37 13 – DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 23 31 13 - Medium and Low Pressure Ductwork

C. Section 23 33 00 - Duct Accessories

D. Section 23 05 93 -Testing, Adjusting and Balancing

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on outlets and inlets including the following:

1. Schedule of Diffusers, Registers and Grilles indicating drawing designation, room location, number furnished, model number, size and accessories furnished.

2. Data sheet for each type of Diffusers, Registers and Grilles and accessory furnished; indicating construction, finish and mounting details.

3. Performance data for each type of Diffusers, Registers and Grilles furnished including: throw at 150/100/50 fpm, total and velocity pressure drop, and noise criteria ratings. Indicate selections on data.

B. Maintenance Data: Submit maintenance instructions including cleaning instructions for finishes and spare parts lists. Include this data in maintenance manuals.

1.3 QUALITY ASSURANCE

A. ASHRAE Standards: Comply with American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE) Standard 70 "Methods of Testing for Rating the Air Flow Performance of Outlets and Inlets."

B. ADC Test Code: Comply with Air Diffusion Council (ADC) Equipment Test Code 1062R4 "Certification, Rating and Test Manual."

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver Diffusers, Registers and Grilles wrapped in factory fabricated fiberboard type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store Diffusers, Registers and Grilles in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering diffusers which may be incorporated in the work include, but are not limited to, the following: Carnes; Carrier; Krueger; Metal Aire; Nailor; Price Industries; Titus; United McGill, or approved equal.

B. General: Provide diffusers, registers, and grilles where shown; of size, shape, capacity and type indicated; constructed of materials, finishes, components, and accessories as indicated, scheduled, and as required for complete installation.

C. Performance: Provide performance data for each type of outlet and inlet furnished including: throw at 150/100/50 fpm, total and velocity pressure drop at vertical throw, and noise criteria ratings at vertical throw.

D. Finish: White baked enamel standard. Color and finish indicated is for submittal to Architect for final approval.

E. Accessories: Round neck on supply diffusers. Adjustable opposed blade damper assembly where indicated. Damper may be integral with slot diffuser throw pattern blades. Insulated supply plenum on linear diffusers as indicated.

F. Mountings:

1. Lay-In: Housing sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bars. Tee bar required on each side.

2. Surface-mounted: Furnish flanged or beveled border for wall or ceiling installation. Flanged borders with gasket and screw holes.

3. Duct-mounted: Diffuser or grille housing and frame designed for installation on exposed duct branch.

2.2 DIFFUSERS, GRILLES, AND REGISTERS

Manufacturer's model numbers are provided to indicate quality and performance specified. Any manufacturer indicated above may submit equivalent models.

Ceiling Diffuser CD-1:
Lay-in: Aluminum construction, 1/2"x1/2"x1" eggcrate, 90% free area,1" flange with no screw holes, 70"x28" nominal neck size, 72"x30" nominal frame dimensions. Baked white enamel finish. Carnes RAPAF, or approved equal. Provide sheetmetal supply plenum.

Supply Register SR-1:
Surface mounted: Steel construction, vertical and horizontal straight double deflection adjustable hemmed or teardrop blades at manufacturer's standard spacing, approximately 3/4" on center. 1" flange with screw holes and gasket. Provide with integral volume damper. Baked white enamel finish. Grille size indicated on drawings. Carnes RSDBH, or approved equal.

Return Grille RG-1, Transfer Grille TG-1, Exhaust Grille EG-1:
Surface mounted: Aluminum construction, 1/2"x1/2"x1/2" eggcrate, 90% free area, 1" flange with screw holes. Baked white enamel finish. Size indicated on drawings. Carnes RAPAF, or approved equal.

Return Grille RG-2, Transfer Grille TG-2, Exhaust Grille EG-2:
Lay-in: Aluminum construction, 1/2"x1/2"x1/2" eggcrate, 90% free area,1" flange with no screw holes, 22"x22" nominal neck size, 23-3/4"x23-3/4" nominal frame dimensions. Baked white enamel finish. Carnes RAPAF, or approved equal.

Open Ended Duct with screen OED: Shop fabricated galvanized sheet metal frame with welded wire fabric constructied of 0.063 gauge wire, ½" x ½" spacing and hot dipped galvanized finish equal to McNichols Co. Weldmesh.

2.3 SLOT DIFFUSERS

Provide all materials and components for a complete slot air distribution system, installed in ceiling type indicated on the architectural drawings. Components include, but not limited to, diffusers, insulated plenums, blank-offs, end caps, spacer clips, hanger clips, and support clips. Pattern controllers shall be capable of throws parallel (horizontal) to ceiling. Finish shall be white baked enamel.

Plenum Slot Diffuser PSD-1&2:
Lay-in mounted: Plenum slot diffuser: Steel construction, adjustable pattern high induction air pattern with factory provided center T-bars compatible with ceiling components and color. Vane air pattern and flow rate adjustment with air pattern having full 180 degree adjustment. Drawings indicate diffuser length and number of slots. Provide uninsulated plenum with interior, vanes and frame painted flat black. Provide round or oval inlet collar to plenum to match duct size serving unit, as indicated on Drawings. Donco DCD, Kees K or approved equal.

Insulate plenums externally per Section 23 07 00.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions. Provide transition at diffuser to match plan duct size with inlet size.

B. Support all duct ceiling inlets and outlet from structure. Provide minimum 28 gage 3/4" angle supports on 2 sides for non-ducted outlets installed in ceiling tiles. Extend angles to T-bar supports.

C. Locate diffusers, registers and grilles as indicated on plans. Unless otherwise indicated on the reflected ceiling plans, locate diffusers, registers and grilles in center of acoustical ceiling modules. Locate lay-in plenum slot diffusers beside T-bar. Install louvered return and exhaust inlets with blade orientation to minimize see through.

D. Where diffusers are located under obstacles prohibiting standard elbow connection, remove round neck and provide square plenum inlet as tall as possible with side connection. Transition duct as required.

3.3 BALANCING

A. Balancing damper shall be installed in duct leading to each outlet and inlet. Refer to

Section 23 05 93 "Testing, Adjusting and Balancing" for balancing of outlets and inlets; not work of this section.

END SECTION 23 37 13

DIVISION 23 - HVAC
SECTION 23 38 00 – COMMERCIAL KITCHEN HOODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of kitchen hood is indicated by drawings and schedules.

B. Types of kitchen hoods in this section include the following:

Type I

C. Refer to Division 26 sections for electrical wiring work required in conjunction with kitchen hoods; not work of this section.

D. Refer to other Division 23 sections for ductwork, fans and duct accessories required in conjunction with the kitchen hoods.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data on kitchen hoods, including dimensions, capacities, ratings, performance characteristics, gages and finishes of materials and installation instructions.

B. Shop Drawings: Submit assembly type shop drawings showing unit dimensions, options, construction details and field electrical connection details.

C. Maintenance Data: Submit maintenance instructions, including cleaning instructions and spare parts lists. Include this data in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of kitchen hoods, of types, ratings and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: Qualified with at least 3 years of successful installation experience on projects with installation work similar to that required for project.

C. NEC Compliance: Comply with applicable installation requirements of NEC pertaining to installation kitchen hoods.

D. UL Compliance: Comply with applicable requirements of UL providing kitchen hoods that are UL listed and labeled.

E. SMACNA Compliance: Comply with applicable requirements of SMACNA.

F. NFPA Compliance: Comply with applicable requirements of NFPA 96 pertaining to the construction and installation of kitchen hoods.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver hoods in factory fabricated type containers. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store hoods in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 TYPE I (GREASE)

A. Acceptable manufacturers: CaptiveAire, Greenheck, or approved equal.

B. Kitchen hoods:

1. Kitchen Ventilation hood(s) shall be of the Type I, exhaust only, wall, back shelf or island canopy suitable for all types of cooking applications as scheduled on the drawings. The hood(s) shall be U. L. Listed without fire damper for 450°F or 600°F rated cooking appliances. Make-up shall be independently provided.

2. The hood(s) exterior shall be constructed of a minimum of 18 gauge stainless steel with a #4 polished finish.

3. An integral 3 inch air space shall be provided to meet NFPA 96 clearance requirements against limited combustible walls. All seams, joints and penetrations of the hood enclosure shall be welded and/or liquid tight Lighter material gauges, alternate material types and finishes are not acceptable. All unexposed interior surfaces shall be constructed of minimum 18 gauge corrosion resistant steel including, but not limited to ducts, plenum, and brackets.

4. The hood(s) shall include a filter housing constructed of the same material as the hood. Provide high efficiency aluminum filters meeting U.L. 1046 Classified and NSF Certification, in sufficient number and sizes to ensure optimum performance. Include additional grease extractor filters to direct the exhaust airflow through individual cyclone chambers, utilizing centrifugal impingement grease extraction technology and removable for cleaning. The filter housing shall terminate in a pitched, full length grease trough which shall drain into a removable grease container.

5. Kitchen hood shall have exhaust balancing baffles at exhaust neck of hood to aid in the balancing of the entire exhaust system.

6. Provide #4 polished stainless steel extensions to match hood face as required to extend a minimum of 2" beyond the ceiling height.

7. Vapor proof, U. L. Listed fluorescent light fixtures shall be prewired to a junction box situated at the top of the hood for field connection. Wiring shall conform to the requirements of the National Electrical Code (NFPA #70-Latest Edition).

8. The hoods shall be provided with a digital temperature interlock system to

automatically start exhaust fan and interlocked supply when cooking operations are detected independent of the manual switch. System shall incorporate a delay control to prevent cycling and turn off fans and turn off fans when temperature drops below setpoint and delay time expires. System shall be designed to meet IMC 507.2.1.1.

9. The hoods shall be built in accordance with National Fire Protection Association (NFPA) Bulletin #96, International Mechanical Code (IMC), Uniform Mechanical Code (UMC), and bear the National Sanitation Foundation (NSF) Seal of Approval. The hood manufacturer shall provide, on request, the necessary data that confirms compliance with the code authorities listed above.

10. The hood volume shall be calculated utilizing a computerized thermal updraft velocity method.

11. The hood(s) shall contain a factory engineered and pre-piped, UL listed, wet chemical fire suppression system. The system piping shall be installed in the hood at the time of construction above the hood or within the supply plenum, and shall be concealed from view. No exposed piping is acceptable, with the exception of appliance drops. A certified local distributor shall be selected by the factory for final system hook-up. The system shall be capable of automatic detection and actuation and/or remote manual actuation. The system shall have the fire suppression capabilities to protect the duct(s), plenum(s), filter area(s) and cooking equipment. Provide remote electrical gas line shut-off valve including a double-pole, double-throw micro-switch for activation of a shunt trip breaker (provided by others) for disconnecting power to electrical cooking equipment. The system shall also include the release assembly, agent tank, detectors, fusible links, liquid-tight fittings, remote manual pull station, and schedule 40 black iron pipe with chrome sleeving for exposed areas.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF KITCHEN HOODS

A. Install kitchen hoods as indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices to ensure proper support and clearances. Comply with applicable installation requirements of NEC, NECA's and NFPA.

B. Coordinate with electrical work, including wiring/cabling work.

C. Clean dust and debris from each hood as it is installed to ensure cleanliness.

D. Install filters and other accessories. Replace damaged accessories where bent or crushed.

E. Touch up, polish or replace sections where scratched or marred to match original finishes.

F. Installation of fire suppression system shall be by licensed installer.

3.3 TESTING

A. Upon completion of installation, test hoods to demonstrate capability and compliance with requirements.

B. Test and certify fire suppression system operation. Installer shall provide copy of written certification to Architect.

C. Refer to Section 23 05 93 "Testing, Adjusting and Balancing" for air distribution balancing of kitchen hoods; not work of this section.

END SECTION 23 38 00

DIVISION 23 - HVAC
SECTION 23 41 00 - AIR TREATMENT EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of work required by this section is indicated on drawings and schedules and/or specified in other Division 23 sections. Equipment specified herein includes the following:

MERV 6 Panel Filter Media	MERV 7 Filter Media
MERV 11 Cartridge Filter Media	housings for MERV 6 panel filter media
housings for MERV 7 filter media	housings for MERV11 filter media
side access filter housings	filter gauges

B. This section contains specifications for filters used in all central station air handling units, fan coil units, cabinet unit heaters, special filter housings, and field erected units, whether located indoors, or outdoors.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data concerning dimensions, materials, efficiencies, installation instructions and appropriate identification. Use UL Class 1 or Class 2 filters unless noted otherwise. Efficiencies indicated in this section are based on ASHRAE Standard 52. Fan motors have been selected to operate against the resistance of dirty filters as specified in this section.

B. Shop Drawings: Submit shop drawings for filter rack assemblies showing dimensions, materials and methods of assembly.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of filter, filter gage and rack required. Include this data in maintenance manual.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air filtering equipment with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ASHRAE Compliance: ASHRAE Standard 52
2. UL Compliance: UL181, UL 586

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS: Subject to compliance with requirements, provide filters and

frames of one of the following: American Air Filter; Barnebey-Cheney; Cambridge; Continental; Flanders; Farr; Mine Safety Appliances; Research Products; or approved equal.

2.2 MERV 6 PANEL FILTER MEDIA

A. Use 1" thick fiber blanket in a cardboard frame with perforated metal retainer. Coat media with flameproof, non- volatile adhesive.

B. Media nominal rating to be 500 FPM face velocity, 0.15 inch WG initial resistance, 0.50 inches WG recommended final resistance. Average arrestance of filter media shall be 80%.

C. Provide filter holding frame.

2.3 MERV 7 FILTER MEDIA

A. Use 2" thick pleated, lofted, non-woven, reinforced fabric, supported and bonded to a welded wire grid, and enclosed in cardboard frame.

B. Media nominal rating to be 500 FPM face velocity, 0.30 inch WG initial resistance, 0.9 inches WG recommended final resistance. Efficiency to be 25-30% dust spot, 90-92% weight arrestance.

C. Furnish a side-access housing or holding frame as scheduled or specified.

2.4 MERV 11 EFFICIENT FILTER MEDIA (AHU final filter for air handling units other than labs or health care facilities. Use cartridge or supported bag for VAV)

A. Media nominal rating to be 500 FPM face velocity, 0.40 inch WG initial resistance, 1.0 inches WG recommended final resistance, 95% dust spot efficiency.

B. Furnish a side-access filter housing or holding frame as scheduled.

2.5 HOUSINGS FOR PANEL FILTERS

A. Manufactured by air handling unit manufacturer, filter media manufacturer, or contractor fabricated. Casing and tracks constructed of galvanized or enameled steel or aluminum.

B. Provide access to the media tracks from outside the casing so media and be readily changed.

2.6 HOUSINGS FOR MERV 7 EFFICIENT FILTER MEDIA

A. Housing or holding frame to be of the same manufacturer as filter media or provided by the air handling unit manufacturer. Contractor fabricated housings or filter racks will not be accepted. Provide flat or angled filter frames as scheduled and detailed. Casing and tracks constructed of galvanized or enameled steel or aluminum.

B. Provide access to the media tracks from outside the casing so media and be readily changed.

2.7 SIDE ACCESS FILTER HOUSINGS

A. Galvanized steel housing with aluminum or galvanized steel filter mounting tracks. Mounting tracks and access doors to have gaskets to minimize air bypass around the

filters. Housing assembly to be suitable for use in duct systems with 4.0 inches of water static pressure.

B. Standard filter sections provided by air handling unit manufacturers shall be used for MERV 11 efficient filters.

C. 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.

D. Furnish housings for MERV 11 with a lever action sealing mechanism to secure media in tracks.

E. Include an integral prefilter track for installation of MERV 7 efficient prefilters.

2.8 FILTER GAUGES

A. Manufacturers: Dwyer; or approved equal.

B. Direct reading, 3-1/2 inch dial type, diaphragm actuated, in a metal case. Lettering shall be black figures on white background. Provide front recalibration adjustment.

C. Provide gauges with the following ranges:

Filter Type	Scale Range (inch W.G.)
Panel filters	0.0 to 0.5
MERV 7 efficient filters	0.0 to 1.0
MERV 11 efficient filters	0.0 to 2.0

D. Provide one gauge for each filter bank, suitable for flush or surface mounting. Include an air filter gauge accessory package consisting of mounting bracket, aluminum tubing, two static pressure tips, and vent valves for each gauge

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 owner prior to substantial completion.

C. Install units as shown on drawings and details according to manufacturer's instructions.

D. Reinforce filter holding frames per manufacturer's instructions.

E. Maintain necessary clearance for changing filters.

3.2 FILTER GAUGES

A. Install filter gauge static pressure tips upstream and downstream of filters.

B. Mount gauge on outside of filter housing or filter plenum in accessible position; install tubing and gauge valves between gauge and sensor tips. Adjust and level each gauge.

END SECTION 23 41 00

DIVISION 23 - HVAC
SECTION 23 51 00 - BREECHINGS, CHIMNEYS AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 23 07 00 - Mechanical Insulation.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's specifications including materials, dimensions, weights, accessories, approvals and installation instructions.

B. Maintenance Data: Include product data in maintenance manual.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of prefabricated breeching of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. NFPA Compliance: Comply with the most current edition of NFPA 211 "Chimneys," Fireplaces, Vents and Solid Fuel Burning Appliances" and the most current edition of NFPA 54 National Fuel Gas Code (ANSI Z223.1).

C. UL Compliance and Labeling: Comply with applicable portions of UL safety standards pertaining to breeching; provide products that have been UL listed and labeled.

D. SMACNA Compliance: Comply with SMACNA Low Pressure Duct Standards for fabricated breeching.

PART 2 – PRODUCTS

2.1 SINGLE WALL METAL BREECHINGS AND STACKS

A. All Steel, Positive Pressure, Single Wall Vents:

1. Utilize single wall positive pressure venting only within the boiler room containing the vented appliance.

2. Manufacturers: Subject to compliance with requirements, provide all steel, positive pressure single wall vents of one of the following: Selkirk – Heat-Fab, Inc; Metal-Fab, Inc; or approved equal.

3. Description: Factory fabricated Gas Vent Connector tested and listed by Underwriters Laboratories to UL 1738/ ULC S636 for use with Listed natural gas or propane equipment that produce flue-gas temperatures not above 550°F.

4. Construction: Fabricate from AL 29-4C Stainless Steel suited for use with high efficiency gas burning equipment which produce condensation in the vent. All

joints to be fastened with factory applied seal tested to be gas tight at 2.5 times the listed pressure rating of 8" water column.

B. Flexible Aluminum Category 1 Chimney Liner

1. Utilize flexible aluminum chimney liners to vent category 1 gas fired appliances within an existing lined chimney or Type B vent.

2. Manufacturers: Subject to compliance with requirements, provide flexible aluminum chimney liner of one of the following: Selkirk – Heat-Fab, Inc; Metal-Fab, Inc; or approved equal.

3. Description: aluminum chimney liner, UL listed for category 1 propane or gas fired appliances, consisting of 2-ply aluminum flex pipe and UL fittings including tees, Type B connectors, and chimney or vent cap adapters.

2.2 DOUBLE WALL METAL BREECHINGS AND STACKS

A. All Steel, Positive Pressure, Double Wall Vents:

1. Utilize double wall positive pressure venting where flue is enclosed within a chase or other building construction.

2. Manufacturers: Subject to compliance with requirements, provide all steel, positive pressure double wall vents of one of the following: Selkirk – Heat-Fab, Inc; Metal-Fab, Inc; or approved equal.

3. Description: Factory fabricated Gas Vent Connector tested and listed by Underwriters Laboratories to UL 1738/ ULC S636 for use with Listed natural gas or propane equipment that produce flue-gas temperatures not above 570°F.

4. Construction: 1" minimum air space between walls; inner jacket of Al 29-4C stainless steel; outer jacket of type 430 stainless steel.

5. Accessories: UL labeled tees, elbows, increasers, draft hood connectors, adjustable roof flashing, storm collar, support assembly, thimbles, fire stop spacers, and fasteners fabricated of similar materials and designs as vent pipe straight sections. Stacks shall be guyed for 100 mph wind loading.

B. Type B Gas Vents (use for natural draft gas-fired appliance venting) :

1. Available Manufacturers: Subject to compliance with requirements, provide Type B double wall gas vents of one of the following: American Metal Products Co., Div. of Masco Corp.; Hart & Cooley Mfg. Co.; Selkirk Metalbestos; Metal-Fab, inc. or approved equal.

2. Description: Double wall gas vents, UL listed for Type B, consisting of an inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, with the following minimum thicknesses:

Size	Inner Pipe	Outer Pipe
Round, up to 6"	0.012"	28 gage
Round, 7" to 18"	0.014"	28 gage
Round, 20" to 24"	0.018"	26 gage

Oval, up to 4"	0.012"	28 gage
Oval, 5" to 6"	0.014"	28 gage

3. Accessories: UL labeled tees, elbows, increasers, draft hood connectors, metal cap with bird barrier, adjustable roof flashing, storm collar, support assembly, thimbles, fire stop spacers, and fasteners, fabricated of similar materials and designs as vent pipe straight sections.

2.3 DIRECT DUCTED COMBUSTION AIR INTAKE

A. Provide galvanized sheet metal, or PVC piping.

1. Galvanized sheet metal shall be equivalent to 2" pressure class ductwork. See Section 23 31 13 for construction and seal class.

2. PVC piping shall be schedule 40 DWV and fittings. Joints to be made using PVC cleaner and cement.

B. See Section 23 07 00 Mechanical Insulation for requirements of concealed intake ducts.

PART 3 - EXECUTION

3.1 INSTALLATION OF SINGLE WALL BREECHINGS AND STACKS

A. Install all steel, positive pressure, single wall vents in accordance with manufacturer's installation instructions, NFPA and UL listings. Use single manufacturer for all components including adapters to boiler, thimbles through building construction, flashings and termination kits.

B. Seal joints between sections of positive pressure vents in accordance with manufacturer's installation instructions, and using only sealants recommended by manufacturer.

C. Install vents parallel to building components maintaining minimum clearances from combustibles as specified in UL listing and pitch as required by manufacturer.

D. Support vents at intervals recommended by the manufacturer to support the weight of the vent and all accessories, without exceeding loading of boilers.

3.2 INSTALLATION OF DOUBLE WALL BREECHINGS AND STACKS

A. Install all steel, positive pressure, double wall vents in accordance with manufacturer's installation instructions and UL listing. Maintain minimum clearances from combustibles specified in UL listing.

B. Seal joints between sections of positive pressure vents in accordance with manufacturer's installation instructions, and using only sealants recommended by manufacturer.

C. Support vents at intervals recommended by the manufacturer to support the weight of the vent and all accessories, without exceeding loading of boilers.

D. Install Type B gas vents in accordance with manufacturer's installation instructions and UL listing. Maintain minimum clearances from combustibles specified in UL listing.

3.3 INSTALLATION DIRECT DUCTED COMBUSTION AIR INTAKE

A. Seal joints in accordance with manufacturer's installation instructions, and using only sealants recommended by manufacturer.

B. Install intake piping parallel to building components maintaining minimum clearances from combustibles and maximum equivalent lengths as specified in UL listing and pitch as required by manufacturer.

C. Support piping at intervals recommended by the manufacturer to support the weight of the vent and all accessories.

3.4 CLEANING AND PROTECTION

A. Clean breechings internally during installation to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth.

B. Temporary Closure: At ends of breechings and chimneys that are not completed or connected to equipment, provide temporary closure which will prevent entrance of dust and debris until installations are completed.

C. Install drains from boiler vent drains to floor drain with trap if required.

END SECTION 23 51 00

DIVISION 23 - HVAC
SECTION 23 52 16 – SEALED COMBUSTION HOT WATER BOILER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of the Agreement and Division 1 shall govern work under this section.

B. Division 23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of boiler work required by this section is indicated on drawings and schedules and by requirements of this section.

B. Refer to other Division 23 sections for concrete pads, piping, breechings, temperature controls, etc. required external to boilers for installation; not work of this section.

C. Electrical Work: Refer to Section 23 05 13 "Electrical Provisions of HVAC Work".

D. Electrical Work: Provide the following wiring as work of this section, in accordance with requirements of Division 26:

1. Provide control wiring between boiler control panel and thermostats, aquastats, pressure stats or any other control device.

2. Provide factory mounted and wired controls and electrical devices as specified in this section.

E. Refer to Division 26 sections for other electrical work including motor starters, disconnects, wires/cables, raceways and other required electrical devices; not work of this section.

1.3 QUALITY ASSURANCE

A. Manufacturer: Aerco

B. Codes and Standards:

1. NFPA Compliance: Install gas fired boilers in accordance with NFPA Code 54 "National Fuel Gas Code."

2. ASME Compliance: Construct boilers in accordance with ASME Boiler and Pressure Vessel Code, Section IV "Heating Boilers."

3. UL and NEMA Compliance: Provide boiler ancillary electrical components which have been listed and labeled by UL and comply with NEMA standards.

4. Warranty Period for Fire-Tube Condensing Boilers: The pressure vessel/heat exchanger shall carry a 7-year from shipment, prorated, limited warranty against any failure due to condensate corrosion, thermal stress, mechanical defects or workmanship.

Manufacturer labeled control panels are conditionally warranted against failure for (2) two years from shipment.

All other components, with the exception of the igniter and flame detector, are conditionally guaranteed against any failure for 18 months from shipment

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed and operating), furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly type shop drawings indicating dimensions, weight loadings, required clearances and methods of assembly of components.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to boilers. Submit manufacturer's ladder type wiring diagrams for interlock and control wiring required for final installation of boilers and controls. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.

D. Maintenance Data: Submit maintenance data and parts list for each boiler, control and accessory; including "troubleshooting" maintenance guide. Include this data, product data, shop drawings and wiring diagrams in maintenance manual; in accordance with requirements of Division 1. Include 10-year guarantee on heat exchanger for failure from thermal shock.

1.5 DELIVERY, STORAGE AND HANDLING

A. Handle boiler components and equipment carefully to prevent damage, breaking and scoring. Do not install damaged sections or components; replace with new.

B. Store boiler components and equipment in clear dry place. Protect from weather, dirt, fumes, water, construction debris and physical damage.

C. Comply with manufacturer's rigging and moving instructions for unloading boilers and moving them to final location.

PART 2 - PRODUCTS

2.1 PACKAGED GAS-FIRED BOILERS - SEALED COMBUSTION

A. Description: Boiler shall be natural gas fired, fully condensing, modular cast sectional design. Each module shall have a modulating forced draft power burner and discharge into a positive pressure vent. The minimum firing rate shall not exceed 45,500 BTU/HR input. Boiler efficiency shall increase with decreasing load (output), while maintaining set point. Boiler shall be factory-fabricated, factory-assembled and factory-tested, condensing boiler with heat exchanger sealed pressure-tight, built on a steel base, including insulated jacket, flue-gas vent, combustion-air intake connections, water supply, return and condensate drain connections, and controls.

B. Heat Exchanger: The heat exchanger is constructed of cast aluminum and shall be capable of handling return water temperatures down to 40 F without any failure due to thermal shock or fireside condensation. It shall be ASME stamped for a working pressure not less than 92 psig. Inspection openings in the pressure vessel shall be in accordance with ASME Section IV pressure vessel code. Access to the fireside of the thermal modules is available by burner removal. Minimum access opening shall be no less than 13.5" x 3.5" per thermal module. The heat exchanger shall have a maximum water volume of 2.8 gallons. The boiler water pressure drop shall not exceed 7.8 ft. w.c. at 28 gpm. The boiler water connections shall be 2-1/2" NPT.

C. Burner, Modulating Gas Valve. and Variable Speed Fan: Each boiler burner module shall be capable of a 6-to-1 turndown ratio of the firing rate without loss of combustion efficiency or staging of gas valves. The burner shall produce less than 14 ppm of NOx corrected to 3% excess oxygen. The burner shall be metal-fiber mesh covering a stainless steel body with spark ignition and flame rectification. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. A modulating gas valve and variable speed fan shall meter the natural gas and air input, respectively.

D. Minimum boiler efficiencies shall be as scheduled.

E. Blower: The boiler shall include a variable-speed, DC centrifugal fan to operate during the burner firing sequence and pre-purge the combustion chamber.

F. Exhaust Manifold/Condensate Tray: The exhaust manifold shall be of stainless steel with a 4"diameter flue connection. The condensate tray shall be of stainless steel and shall have a gravity drain for the elimination of the condensation with P-trap.

G. Motors: Blower motors shall comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

H. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require a motor to operate in the service factor range above 1.0.

I. Ignition: Ignition shall be via spark ignition with 100 percent main-valve shutoff and electronic flame supervision.

J. CONTROLS

1. Refer to Division 23 90 00.

2. The boiler control system shall consist of a master controller (E8 Controller) to which individual thermal module controllers are linked as slaves. The entire system shall be CSA Recognized. Each of the thermal module controllers shall consist of a combustion safeguard. Individual thermal module controllers shall be field replaceable. The combustion safeguard/flame monitoring system shall utilize spark ignition and a rectification type flame sensor. The boiler control system shall annunciate boiler & sensor status and include extensive self-diagnostic capabilities.

   A second master controller (Boiler Communications Module) shall 1) serve as the master controller in the event that the E8 Controller fails, 2) incorporate a fault relay for simple remote fault alarm, and 3) allow third party Building Automation System (BAS) to control and monitor the boiler via Modbus RS-485 communications.

   Each boiler shall incorporate dual over-temperature protection with manual reset and an electric low water cut-off with manual reset, both in accordance with ASME

Section IV

3. When set on Internal Set point Mode, temperature control set point on the BMS shall be fully field adjustable from 50°F to 190°F in operation. When set on Indoor/Outdoor Reset Mode, the BMS will operate on an adjustable inverse ratio in response to outdoor temperature to control the main header temperature. Reset ratio shall be fully field adjustable from 0.3 to 3.0 in operation. When set on 4ma to 20ma Temperature Control Mode, the BMS will operate the plant to vary header temperature set point linearly as an externally applied 4-20 ma signal is supplied.

4. When set on MODBUS Temperature Control Mode, the BMS will operate the plant to vary header temperature set point as an external communication utilizing the MODBUS protocol is supplied via the RS-232 port. The BMS controller shall have a vacuum fluorescent display for monitoring of all sensors and interlocks. Non-volatile memory backup of all control parameters shall be internally provided as standard. The controller will automatically balance the sequence of operating time on each boiler by a first-on first-off mode and provide for setback and remote alarm contacts. Connection between central BMS system and individual boilers shall be twisted pair low voltage wiring, with the boilers 'daisy-chained' for ease of installation.

K. VENTING

1. The exhaust vent must be UL Listed for use with Category III and IV appliances and compatible with operating temperatures up to 480°F, positive pressure, condensing flue gas service. UL-listed vents of Al 29-4C stainless steel must be used with boilers.

2. The vent must be sized in accordance with AERCO's recommendations.

3. Combustion-Air Intake: Boilers shall be capable of drawing combustion air from the outdoors via a metal duct connected between the boiler and the outdoors.

4. The minimum sealed combustion air duct size for each boiler is four-inch diameter.

5. Follow guidelines specified in manufacturer's venting guide.

L. CONDENSATE NEUTRALIZATION

1. Provide boiler condensate neutralization devices in boiler drains to protect the sanitary system from acid generated by the combustion process.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which boilers are to be installed, and substrate which will support boilers. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF BOILERS

A. General: Install boilers in accordance with manufacturer's installation instructions, in accordance with State and local code requirements, and in accordance with requirements of local Utility Company. Install units plumb and level, to tolerance of 1/8" in 10'-0" in both directions. Maintain manufacturer's recommended clearances around and over boilers.

B. Support: Install boilers on 3-1/2" thick concrete pad, 4" larger on each side than base of unit. Boilers to sit on neoprene isolation pads on top of concrete pads.

C. Erection: Assemble boiler trim shipped loose, or unassembled for shipment purposes. Follow manufacturer's installation instructions.

D. Electrical Work: Install electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

E. Verify that electrical work installation is in accordance with Division 26 sections. Do not proceed with equipment start-up until electrical work is acceptable to equipment Installer.

F. Gas Piping: Refer to Section 23 11 23 "Natural Gas Piping Systems". Connect gas piping to boiler, full size of boiler gas train inlet, provide union with sufficient clearance for burner removal and service.

G. Each natural gas boiler shall require a minimum gas pressure of 4" W.C. at full load rated capacity. For applications with gas supply pressure greater than 14" W.C., each boiler shall be provided with an individual supply gas regulator by installing contractor for proper gas regulation.

H. Hot Water Piping: Refer to Section 23 21 13 "Hydronic Piping". Connect supply and return boiler tappings as indicated and in accordance with manufacturer's instructions, with shutoff valve and union or flange at each connection.

I. Venting: Refer to Section 23 51 00 "Breechings, Chimneys, and Stacks". Connect breeching to boiler outlet, full size of outlet. Route as indicated. Install combustion air duct per manufacturer's recommendation. Seal all ducts and vents per manufacturer's requirements.

3.3 FIELD QUALITY CONTROL

A. Flush and clean boilers upon completion of installation, in accordance with manufacturer's start-up instructions.

B. Hydrostatically test assembled boiler and piping in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.

C. Arrange with National Board of Boiler and Pressure Vessel Inspectors for inspection of boiler piping, observation of hydrostatic testing, and for certification of completed boiler units.

D. Start-up boilers in accordance with manufacturer's start-up instructions and in the presence of the boiler manufacturer's representative. Test controls and demonstrate compliance with requirements. Adjust burner for maximum burning efficiency. Replace damaged or malfunctioning controls and equipment.

3.4 CLOSEOUT PROCEDURES

A. Owner's Instructions: Provide services of manufacturer's technical representative for 2-hours to instruct Owner's personnel in operation and maintenance of boilers. Schedule training with Owner, provide at least 7-day notice to Contractor and Engineer of training date.

END SECTION 23 52 16

DIVISION 23 - HVAC
SECTION 23 62 13 - AIR COOLED CONDENSING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 23 05 00 HVAC General Provisions

C. Section 23 23 00 - Refrigerant Piping

1.2 SUBMITTALS

A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities of selected model clearly indicated, dimensions, required clearances, shipping, installed, and operating weights, furnished specialties, accessories, and installation and startup instructions.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location of each field connection. Detail equipment mounting to supporting structure.

C. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

D. Operation and Maintenance Data: Submit maintenance data and parts list for each condensing unit, control and accessory; including "trouble shooting" maintenance guide; plus servicing and preventative maintenance procedures and schedule. Include this data and product data in maintenance manual; in accordance with requirements of Division 1.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of condensing units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Refrigeration system of condensing units shall be constructed in accordance with ASHRAE Standard ASHRAE 15 "Safety Code for Mechanical Refrigeration."

2. Condensing units shall be listed by UL and have UL label affixed.

1.4 DELIVERY, STORAGE AND HANDLING

A. Handle condensing units and components carefully to prevent damage. Follow manufacturer's written instructions for rigging. Replace damaged condensing units or components.

B. Store condensing units and components in clean, dry place off the ground. Protect from weather, water and physical damage.

1.5 SPECIAL PROJECT WARRANTY

A. The refrigeration equipment manufacturer's warranty shall be for a period of one year from date of equipment start up but not more than 18 months from date of original equipment shipment from the factory. The warranty shall cover material and workmanship that prove defective within the above period, excluding refrigerant.

B. Compressors shall carry a 5 warranty from date of original equipment shipment from the factory.

PART 2 - PRODUCTS

2.1 AIR COOLED CONDENSING UNITS (5 tons or Greater)

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering air cooled condensing units which may be incorporated in the work include, but are not limited to, the following: AAON; Carrier Air Conditioning, Div. of Carrier Corp.; McQuay, Inc.; Trane Co.; or approved equal.

B. General: Factory assembled and tested air cooled condensing units, consisting of casing, compressors, condensers, coils, condenser fans and motors and unit controls. Capacities and electrical characteristics are scheduled on the drawings.

C. Unit Casings: Designed for outdoor installation and complete with weather protection for components and controls, and complete with removable panels for required access to compressors, controls, condenser fans, motors and drives. Additional features include:

1. Galvanized steel casing (for exposed surfaces) treated and finished with manufacturer's standard paint coating; lifting lugs to facilitate rigging of units; factory installed metal grilles for protection of condenser coil during shipping, installation and operation.

D. Compressor:

1. The compressors shall tandem sealed hermetic scroll type, with inherent thermal overload protection and shall be mounted on rubber vibration isolators. One compressor shall be Copeland Digital Scroll with time proportional modulating from 10 to 100%, in order to match the load at the air-handling unit.

2. Each compressor shall be furnished with a crankcase heater.

E. Controls: Power and starting components shall include fan motor contactors, 5 minute off time delay relay(s) for the compressor(s), inherent fan motor overload protection and unit power terminal blocks for connection to remote disconnect switch. Safety and operating controls shall include a manually reset high pressure switch and an automatic reset low pressure switch. Barrier panels shall be furnished to protect against accidental contact with line voltage when accessing the control system.

F.

1. A centrally located weatherproof control panel shall be isolated from condenser coil airflow, and shall contain the field power connection points, control terminal block and control system.

2. Control circuit transformer and wiring shall provide 24V control voltage from the line voltage provided to the unit.

G. Condensing Section:

1. The condenser coils shall consist of seamless copper tubes mechanically bonded into plate type aluminum fins. The fins shall have full drawn collars to completely cover the tubes. A subcooling section shall be an integral part of the main condenser coil.

2. The condenser fan(s) shall be propeller type arranged for vertical air discharge, and driven by a direct drive fan motor. The fan discharge area shall be equipped with a heavy-gauge fan guard.

3. Fan motor(s) shall be weather protected, single-phase, direct drive, 1100 rpm, open drip-proof type.

H. Ambient Control: Factory installed standard ambient control.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install condensing units in accordance with manufacturers installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support:

1. Install ground mounted units on 4" thick reinforced concrete pad, provided by G.C.

2. Air Cooled Condensing Units: Connect refrigerant piping to unit; maintain required access to unit.

3.2 FIELD QUALITY CONTROL

A. Testing: Refer to Section 23 23 00 - Refrigerant Piping.

3.3 DEMONSTRATION

A. Provide services of manufacturer's authorized service representative to provide start-up service and to instruct Owner's personnel in operation and maintenance of condensing units.

B. Start-up condensing units in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

C. Train Owner's personnel on start-up and shutdown procedures, trouble shooting procedures, servicing and preventative maintenance schedule and procedures. Review with the Owner's personnel the data contained in the Operating and Maintenance Manuals specified in Division. Schedule training with Owner, provide at least 7 day prior notice to Architect/Engineer.

END SECTION 23 62 13.

DIVISION 23 - HVAC
SECTION 23 72 23 – AIR TO AIR ENERGY RECOVERY UNIT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of energy reclaim work required by this section is indicated on drawings and schedules and by requirements of this section.

B. Types of unit specified in this section include the following:

Enthalpy exchange device

C. Refer to other Division 23 sections for insulation of heat reclaim ducts; not work of this section.

D. Refer to other Division 23 sections for hangers, specialties and controls required in conjunction with energy recovery ventilators; not work of this section.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of heat reclaim devises, of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. The energy recovery cores used in these products shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacture's published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently AHRI Certified will not be accepted.

C. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA 90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.

D. Unit shall be Listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers. Some exceptions to UL Listing may apply. Units intended for "Outdoor Use" shall be listed using the specific UL requirements for rain penetration, corrosion protection and seal durability and shall be so labeled.

E. The ERV core shall be warranted to be free of manufacturing defects and to retain its

functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase. The balance-of-unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two years from the date of purchase.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for energy recovery ventilators including performance data, materials, dimensions, weights and installation data. Independent wheel testing to document that the desiccant material utilized does not transfer pollutants typically encountered in the indoor air environment shall be provided from a credible test laboratory. The cross-contamination and performance certification reports must be provided for engineering review as part of the submittals for this project.

B. Shop Drawings: Submit manufacturer's assembly type shop drawings indicating dimensions, weight loadings, required clearances and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and parts list for the energy recovery ventilator. Include this data in maintenance manual.

1.5 PRODUCTS DELIVERY, STORAGE AND HANDLING

A. Handle energy recovery ventilators carefully to prevent damage, breaking, denting and scoring. Do not install damaged units or components; replace with new.

B. Store energy recovery ventilators in clean dry place. Protect from weather, dirt, fumes, water and construction debris and physical damage.

C. Comply with manufacturer's rigging and installation instructions for unloading energy recovery ventilators and moving them to final location.

PART 2 - PRODUCTS

2.1 ENERGY RECOVERY VENTILATOR (ERV)

A. Energy Transfer: The ERV shall be capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one air stream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.

1. Passive Frost Control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

2. Positive Airstream Separation: Water vapor transfer shall be through molecular transport by hydroscopic resin and shall not be accomplished by "porous plate" mechanisms. Exhaust and fresh airstreams shall travel at all times in separate passages, and airstreams shall not mix.

B. Construction: The energy recovery component shall be of fixed-plate cross-flow construction, with no moving parts. No condensate drain pans or drains shall be allowed and unit shall be

capable of operating in both winter and summer conditions without generating condensate.

1. The unit case shall be constructed of G90 galvanized, 20-gauge steel, with lapped corners and zinc plated screw fasteners. The unit roof shall be one piece or have watertight standing seam joints and shall overlap wall panels and doors in order to positively shed water.
2. Access doors shall provide easy access to blowers, ERV cores, and filters. Doors shall have an airtight compression seal using closed cell foam gaskets rated for outdoor exposure. Pressure taps, with captive plugs, shall be provided allowing cross-core pressure measurement allowing for accurate airflow measurement.
3. Weatherhoods shall be screened to exclude birds and animals. Inlet weatherhoods shall be sized to maintain inlet velocities below 500 fpm, and equipped with rain excluder baffles.
4. Case walls and doors shall be insulated with 1 inch, 4 pound density, foil/scrim faced, high-density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with minimum R-value of 4.3 (hr·ft2·°F/BTU).

C. The ERV cores shall be protected by a MERV-8 rated, 2" nominal, pleated, disposable filter in both airstreams.
D. Unit shall have single-point power connection and a single-point 24 VAC contactor control connection
E. Blower motors shall be EISA compliant for energy efficiency with open drip proof design and integral thermal protection.
F. Blowers shall be quiet running, forward curve type and be direct drive..
G. The unit electrical box shall include a factory installed, non-fused disconnect switch and a 24 VAC, Class II transformer/relay package.
H. Provide unit and duct connection orientation per project schedule.
I. Units are available single or three phase at a full range of operating voltages. See project schedule.
J. Provide motor horsepower as specified in project schedule.
K. Provide factory installed disconnect fuses.
L. Provide factory installed filter monitors for each airstream.
M. Provide 14 inch high, non-pitched roof curbs as available from the factory.
N. Manufacturer: Subject to compliance with requirements, provide centrifugal fans of one of the following: RenewAire; or approved equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which heat reclaim wheels are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Install reclaim wheel into system per manufacturer's recommendations. Provide vibration isolation at duct connections.

3.2 ADJUSTING AND CLEANING

A. Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch up paint.

3.3 INSTALLATION OF ENERGY RECOVERY UNITS

A. General: Attach units to associated air handling units or mount independently on roof or in building as indicated on drawings.

B. Support: Install and secure energy recovery units on curbs or from structure, as indicated on drawings. Provide for manufacturer's recommended clearance for maintenance and inspection.

C. Electrical Connections: Refer to Division 16 sections for electrical connections for equipment for final connections to equipment and installation of loose shipped electrical components.

END SECTION 23 72 23

DIVISION 23 - HVAC

SECTION 23 74 15 - INDOOR AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Applicable provisions of Division 1 and Division 23 shall govern work under this section.

1.2 DESCRIPTION OF WORK

A. Extent of packaged heating and cooling units work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of packaged heating and cooling units specified in this section include the following:

1. Variable air volume units, indoor packaged units, 15-tons and smaller.

C. Refer to other Division 23 sections for automatic temperature controls not factory installed, and required for conjunction with packaged heating and cooling units; not work of this section.

D. Electrical Work: Refer to Division 23 Section 23 05 13 "Electrical Provisions" for requirements.

E. Electrical Work: Provide the following wiring as work of this section, in accordance with requirements of Division 26:

1. Provide control wiring between unit mounted control panel and thermostats, remote control panels, and any other control device furnished as work of this section.
2. Provide factory mounted and wired controls and electrical devices as specified in this section.

F. Refer to Division 26 sections for other electrical work including motor starters, disconnects, wires/cables, raceways, and other required electrical devices; not work of this section.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of packaged heating and cooling units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standard

1. Unit shall be certified in accordance with UL Standard 1995, Safety Standard for Heating and Cooling Equipment.

2. Unit shall be safety certified by ETL and be ETL US and ETL Canada listed. Unit nameplate shall include the ETL/ETL Canada label.

1.4 SUBMITTALS

A. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, fan performance, filter information, factory supplied accessories, electrical characteristics and connection requirements.

B. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, construction details, clearances, and connection details. Computer generated fan curves for each blower shall be submitted with specific design operation point noted. Wiring diagram shall be provided with detail for power and control systems and differentiate between factory installed and field installed wiring.

D. Maintenance Data: Submit maintenance data and parts list for each packaged heating and cooling unit, control, and accessory; including "trouble shooting" maintenance guide. Include this data with requirements of Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be wrapped in plastic prior to shipment to prevent damage during transport and thereafter while in storage awaiting installation.

B. Follow Installation, Operation and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.

C. Unit shall be handled carefully to avoid damage to components, enclosures and finish.

D. Unit shall be stored in a clean, dry place protected from weather and construction traffic in accordance with Installation, Operation and Maintenance manual instructions.

1.6 WARRANTY

A. Manufacturer shall provide a limited "parts only" warranty for a period of 12 months from the date of equipment start up or 18 months from the date of original equipment shipment from the factory, whichever is less. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts and air filters.

PART 2 - PRODUCTS

2.1 VARIABLE VOLUME, INDOOR PACKAGED UNITS, 15 TONS AND SMALLER

A. General: Provide factory assembled and tested packaged variable air volume indoor air handling unit shall include filters, supply fans, DX evaporator coil, hot water coil, mixing box and unit controls.

B. Construction

1. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel and prevents exterior condensation on the panel.

2. Unit insulation shall have a minimum thermal resistance R-value of 6.25. Foam insulation shall have a density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 610°F.

3. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Sealing shall be included between panels and between access doors and openings to reduce air leakage. Refrigerant piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

4. Access to filters, cooling coil, heating coil, supply fans and electrical and controls components shall be through hinged access doors with lockable handles.

5. Units with cooling coils shall include a 304 stainless steel sloped drain pan. Drain pan connection shall be on the either side of the unit.

C. Evaporator Cooling Coil

1. Coil shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings.

2. Coil with dual circuits shall have interlaced circuitry.

3. Coil shall be helium leak tested.

4. Coil shall be furnished with a factory installed thermostatic expansion valves. The sensing bulbs shall be field installed on the suction line immediately outside the cabinet.

5. Coil shall have external piping connections as shown on the drawing. Liquid and suction connections shall be sweat connection. Coil connections shall be labeled, extend beyond the unit casing and be factory sealed with grommets that cover both the interior and exterior of the unit casing, to minimize air leakage and condensation inside the panel assembly.

D. Hot Water Heating Coil

1. Coil shall be certified in accordance with AHRI Standard 410 and be leak tested.
2. Coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings.
3. Coil shall have external piping connections, as shown on the drawing. Supply and return connections shall be sweat connection. Coil connections shall be labeled, extent beyond the unit casing and be factory sealed with grommets that cover both the interior and exterior of the unit casing, to minimize air leakage and condensation inside the panel assembly.
4. Coil shall be located in the preheat position upstream of the cooling coil.

E. Supply Fans

1. Unit shall include direct drive, un-housed, backward curved, plenum supply fans.

2. Blower and motor assembly shall be dynamically balanced and mounted on rubber isolators.

3. Motor shall be a high efficiency electrically commutated motor with factory installed variable speed drive.

F. Filters: Provide filter box with integral filter rack and hinged access door on both sides.
1. Filter Type: 2" MERV 7 pre-filter.
2. Filter Type: 4" MERV 11 final filter.

G. Mixing Box

1. Unit shall contain a mixing box with front return air opening and top outside air opening.

2. Return and outside air openings shall contain adjustable, motor operated outside air damper assemblies constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Dampers shall be controlled by a field mounted actuator, provided by T.C.C.

H. Temperature Control: Field installed controls. Refer to Division 23 90 00; not work of this section.

I. Manufacturers: Subject to compliance with requirements, provide variable air volume units of one of the following:

AAON
Carrier Air Conditioning;
McQuay Air Conditioning;
Trane Co.
Approved Equal

PART 3 - EXECUTION

3.1 INSPECTION

General: Examine areas and conditions under which packaged heating and cooling units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF PACKAGED HEATING AND COOLING UNITS

A. General: Install packaged heating and cooling units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install units on concrete platform. Cast anchor bolt inserts into platform to secure unit.

C. Electrical Wiring: Install electrical devices furnished by manufacturer's wiring diagram submittal to electrical installer.

Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

D. Ductwork: Refer to Division 23 Sections 21 31 13, 23 31 14 and 23 33 00 "Ductwork". Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size.

1. Connect outside air duct to unit with flexible connection, provide manual damper, quadrant and lock.
2. Connect condenser supply and exhaust ducts to unit with flexible connections.

F. Air Cooled Condenser Piping: Refer to Division 23 Section 23 23 00 "Refrigeration". Connect liquid and hot gas piping to unit as indicated.

G. Hot Water Heating Coil Piping: Refer to Division 23 Section 23 21 13 "Hydronic Systems". Connect supply and return piping to hot water coil as indicated, with unions and shutoff valves.

l. Drain Piping: Connect unit drain to nearest indirect waste connection. Provide trap at drain pan; construct at least 1" deeper than fan pressure in inches of water.

3.3 FIELD QUALITY CONTROL

General: Start-up packaged heating and cooling units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

3.5 SPARE PARTS

General: Furnish to Owner, with receipt, the following spare parts for each indoor air handling unit:

1. One set filters for each unit.

END SECTION 23 74 15

DIVISION 23 - HVAC
SECTION 23 74 23 - PACKAGED, DIRECT-FIRED, OUTDOOR, HEATING-ONLY MAKEUP-AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of work for make-up air units is indicated by drawings and schedules.

B. Types of make-up air units in this section include the following:

Roof mounted packaged units

C. Refer to Division 26 sections for electrical wiring work required in conjunction with make-up air units; not work of this section.

D. Refer to other Division 23 sections for ductwork, duct accessories, and gas piping required in conjunction with make-up air units.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data on make-up air units, including dimensions, capacities, ratings, performance characteristics, gages and finishes of materials and installation instructions.

B. Shop Drawings: Submit assembly type shop drawings showing unit dimensions, options, construction details and field electrical connection details.

C. Maintenance Data: Submit maintenance instructions, including cleaning instructions and spare parts lists. Include this data in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of packaged heating equipment, of types, ratings and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: Qualified with at least 3 years of successful installation experience on projects with installation work similar to that required for project.

C. NEC Compliance: Comply with applicable installation requirements of NEC.

D. Unit construction shall comply with ANSI Z83.4 - Direct Gas Fired Makeup Air

Heaters

E. SMACNA Compliance: Comply with applicable requirements of SMACNA.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver equipment with factory installed shipping skids and lifting lugs; pack components in factory fabricated protective containers.

B. Handle equipment carefully. Do not install damaged components; replace and return damaged components to manufacturer.

C. Store equipment in clean dry place and protect from weather and construction traffic. Comply with manufacturer's rigging and installation instructions.

PART 2 - PRODUCTS

2.1 MAKEUP-AIR UNIT

A. The casing shall be weather tight, 1" insulated thick double wall with galvanized or bonderize prime coated sheet metal panels, continuous welded angle reinforcing, hinged access panels with ¼-turn latches for access into the fan and burner sections and lifting lugs. The entire casing shall be primed and finished with two coats of baked enamel.

B. Inlet damper on the intake hood with electric motor operator having spring return and end switch, shall be provided with each unit. Damper operator shall be designed to operate satisfactorily down to 30 degrees below zero.

C. Filter section shall consist of a casing, hinged and latched access panel, filter channels and 2" thick MERV-8 disposable pleated air filters. V- Bank configuration to maintain filter face velocity not to exceed 500 fpm. See Section 23 41 00.

D. The inlet cowl shall be fitted with a bird screen and be designed to afford weather protection.

E. Factory installed 115 volt GFI service receptacle. Power wiring by E.C.

F. The units shall be Captiveaire, Greenheck, or Modine.

2.2 FAN

A. Fan shall be centrifugal type double inlet with forwardly curved blades discharging through the floor of the unit. Bearings shall be self-aligning grease lubricated with extended grease lines. Fan drive shall be multiple V belt with belt guard, fixed pulleys and adjustable motor base. The fan and motor shall be mounted on a welded structural steel base and the fan isolated from the base with steel spring vibration isolators. Vibration isolators shall be adequate so as to require no additional isolators for the unit.

B. Motor shall be single speed as scheduled on the drawings, "premium efficiency" series. Refer to Section 23 05 13 – 'Common Motor Requirements for HVAC Equipment'. Motor and drive shall be protected in a weatherproof enclosure.

2.3 BURNER

A. Burner shall be natural gas designed for direct-firing with a minimum turndown ratio of 20:1. An observation port shall be provided in the section. Gas train shall conform to IRI requirements with spark ignited pilot, designed for gas delivery pressure of 14" W.C. Burner shall not operate unless the motorized inlet damper on the intake hood is open and supply fan is operating. Safeties shall be incorporated to shut the unit down on pilot or main flame failure.

2.4 CONTROLS

A. Provide complete with the following electric controls: Factory installed motor starter with auxiliary contacts, control transformer, high temperature limit switch, low outlet temperature shut-off, high and low flow proving switches, automatic mild weather burner lockout. Contain all electrical in a NEMA 1 control box with fused disconnect. Provide BAS input terminals for control of supply fan and burner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The curb mounted unit shall be furnished with an 18" minimum height continuous insulated steel roof curb. The curb shall be designed for the slight slope of the roof to insure leveling of the unit. Flashing and counter flashing shall be provided to afford a watertight and weather tight installation. Non curb mounted units shall be installed on roof rails provided by G.C.

B. Field check-out and start-up shall be performed by a factory service representative.

END SECTION 23 74 23

DIVISION 23 - HVAC
SECTION 23 90 00 – TEMPERATURE CONTROL SYSTEM

PART 1 - GENERAL

1.1. SUMMARY
Furnish all labor, materials, equipment, and service necessary for a complete and operating Temperature Control System (TCS) and Facility Management system (FMCS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.

All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).

1.2. SYSTEM DESCRIPTION
The entire Temperature Control System (TCS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via LonMark™/LonTalk™ and/or BACnet™ communication protocols to a Network Area Controller (NAC). Temperature Control System products shall be by approved manufacturers.

The Temperature Control Systems (TCS) consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and perform functions specified.

The Facility Management and Control System (FMCS) shall be comprised of Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the owner's local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each NAC shall communicate to LonMark™/LonTalk™ (IDC) and/or BACnet™ (IBC) controllers and other open protocol systems/devices provided elsewhere.

The Facility Management and Control System (FMCS) as provided in this Division shall be based on a hierarchical architecture incorporating the Niagara AX Framework™. Equivalent products must be approved in writing by the consulting Engineer and be submitted for approval ten (10) days prior to the date of the bid submittal. Systems not developed on the Niagara AX Framework™ platform are unacceptable.

The Facility Management and Control System (FMCS) shall monitor and control equipment as called for by the "Sequence of Operation" and points list.

The Facility Management and Control System (FMCS) shall provide full graphic software capable of complete system operation for up to 34 simultaneous Thin-Client workstations.

The Facility Management and Control System (FMCS) shall provide full graphic operator interface to include the following graphics as a minimum:

- Home page to include a minimum of six critical points, i.e. Outside Air Temperature, Outside Air Relative Humidity, Enthalpy, KWH, KW etc.
- Graphic floor plans accurately depicting rooms, walls, hallways, and showing accurate locations of space sensors and major mechanical equipment.

- Detail graphics for each mechanical system to include; AHUs (Air Handling Units), ERUs (Energy Recovery Units), TUs (Terminal Units), EFs (Exhaust Fans), Chillers and associated controls, Boilers, and Converters as a minimum.
- Access corresponding system drawings, technical literature, and sequences of operations directly from each system graphic.

The Facility Management and Control System (FMCS) shall provide the following data links to electronically formatted information for operator access and use:

- Project control as-built documentation; to include all TCS drawings and diagrams converted to Adobe Acrobat .pdf files.
- TCS Bill of Material for each system, i.e. AHU, RTU, FCU, Boiler etc.
- Technical literature specification data sheets for all components listed in the TCS Bill of Material.
- Sequence of operation for all TCS provided systems.

The FMCS shall provide automated alarming software capable of sending messages to email compatible cellular telephones and pagers via the owner's e-mail service. The email alarm paging system shall be able to segregate users, time schedules, and equipment, and be capable of being programmed by the owner.

It is preferable that any dedicated configuration tool required for controller configuration have the capability to be launched from within the applicable Network Management Software. If the configuration tool(s) cannot be launched from the Network Management Software, any software required for controller configuration shall be included as a leave-behind tool with enough license capability to support the installation.

The contractor shall provide the appropriate quantity of legal copies of all software tools, configuration tools, management tools, and utilities used during system commissioning and installation. All tools shall be generally available in the market. No closed and/or unavailable tools will be permitted. Contractor shall convey all software tools and their legal licenses at project close out.

All necessary software to form a complete operating system, as described in this specification, shall be provided as an integral part of the supervisory controller, and shall not be dependent upon higher level computer for execution.

1.3. CONTRACTOR QUALIFICATION

The contractor shall be certified and trained by the TCS and FMCS manufacturer. The firm must be specializing and experienced in DDC control system installation for no less than 3 years. All engineering and commissioning work shall be done by qualified employees of this manufacturer, or qualified employees of an Authorized Representative of that manufacturer that provides engineering and commissioning of the manufacturer's control equipment.

Where installing contractor is an authorized representative of the control equipment manufacturer, submit written confirmation of such authorization. Indicate in letter of authorization that the installing contractor has successfully completed all necessary training required for the engineering, installation, and commissioning of equipment and systems to be provided for the project and that such authorization has been in effect for a period of not less than three years. The letter of authorization should also indicate that the installing contractor is authorized to install the manufacturer's DDC equipment at the project location at the time the project is bid. Installation of the equipment shall be done by qualified mechanics and/or electricians in the direct employ or be directly subcontracted and under the supervision of the manufacturer or Authorized Representative.

The contractor must have a service office within 20 miles of the building location. Response Time During warrantee period, must be four (4) hours or less, 24-hours/day, 7 days/week.

1.4. SUBMITTAL

Copies of shop drawings of the components and devices for the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions for all controllers, valves, dampers, sensors, routers, etc. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package:

- Damper Schedule: Damper and actuator sizing shall be performed, and a schedule created by the manufacturer. The schedule shall include a separate line for each damper and a column for each of the damper attributes: Damper Identification Tag, Location, Damper Type, Damper Size, Duct Size, Arrangement, Blade Type, Velocity, Pressure Drop, Fail Position, Actuator Identification Tag, Actuator Type, and Mounting.
- Valve Schedule: Valve sizing shall be performed, and a schedule created by the valve manufacturer. The schedule shall include a separate line for each valve and a column for each of the valve attributes: Valve Identification Tag, Location, Valve Type, Valve Size, Pipe Size, Configuration, Flow Characteristics, Capacity, Valve C_V, Calculated C_V, Design Pressure Drop, Actual Pressure Drop, Fail Position, Close off Pressure, Actuator Identification Tag, and Actuator Type.

Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media, and protocol. The Systems Integrator shall be responsible for integrating those diagrams into the overall trunk cable schematic diagrams for the entire Wide Area Network (WAN) and/or Local Area Network (LAN) utilized by the FMCS.

The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system expansion with minimal infrastructure modifications.

Submittal shall also include a complete point list of all points to be connected to the TCS and FMCS. Contractors shall provide necessary point lists, protocol documentation, and factory support information for systems provided in their respective divisions but integrated into the FMCS.

Submittal shall also include a copy of each of the graphics developed for the Graphic User Interface including a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation. The graphics are intended to be 80% - 90% complete at this stage with the only remaining changes to be based on review comments from the A/E design team and/or Owner.

Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ or Visio™ compatible files. Copies of the 'as-built' drawings shall be provided in addition to the documents on compact disk. Sub- and other contractors shall provide as-builts for their portions of work. The contractor shall be responsible for as-builts pertaining to overall TCS and FMCS architecture and network diagrams. All as-built drawings shall also be installed into the FMCS server in a dedicated directory.

1.5. SPECIFICATION NOMENCLATURE

Acronyms used in this specification are as follows:

DDC	Direct Digital Controls
FMCS	Facility Management and Control System
GUI	Graphical User Interface
IBC	Interoperable BACnet Controller

IDC	Interoperable Digital Controller
LAN	Local Area Network
NAC	Network Area Controller
OOT	Object Oriented Technology
PICS	Product Interoperability Compliance Statement
PMI	Power Measurement Interface
POT	Portable Operator's Terminal
TCS	Temperature Control System
WAN	Wide Area Network
WBI	Web Browser Interface

1.6. AGENCY AND CODE APPROVALS

All products of the TCS and FMCS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
UL-916; Energy Management Systems
C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "signal Equipment"
CE
FCC, Part 15, Subpart J, Class A Computing Devices

1.7. SOFTWARE LICENSE AGREEMENT

The Owner shall agree to the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, FMCS, and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner.

The owner, or his appointed agent, shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and /or configured for use within Niagara AX Framework (Niagara) based controllers and/or servers and any related LAN / WAN / Intranet and all connected routers and devices.

PART 2 - MATERIALS

2.1. GENERAL

The Temperature Control System (TCS) and Facility Management Control System (FMCS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein.

The installed system shall provide secure password access to all features, functions and data contained in the overall FMCS.

2.2. ACCEPTABLE MANUFACTURERS

Basis-of-Design: Honeywell WEBs-AX™. Subject to compliance with requirements, provide either the product named or an alternate product by one of the other manufacturers specified.

- Honeywell Spyder Controllers

2.3. OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet™, LonWorks™ technology, MODBUS ™, OPC, and other open and proprietary communication protocols into one open, interoperable system.

The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-2001, BACnet and LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file and a resource file for the device. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP,) and/or RS-485 (BACnet MSTP) as specified.

All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. Systems requiring proprietary database and user interface programs shall not be acceptable.

A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable:

- Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for local network connected user interfaces.
- Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.4. NETWORKS

The Local Area Network (LAN) shall be a 1000 Megabit/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

Local area network minimum physical and media access requirements:

- Ethernet; IEEE standard 802.3
- Cable; 100 Base-T, UTP-8 wire, category 5
- Minimum throughput; 1000 Mbps.

2.5. NETWORK ACCESS

For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The Owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP).

2.6. NETWORK AREA CONTROLLER (NAC)

The contractor shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of area controllers required is dependent on the type and quantity of devices provided specified here and elsewhere.

The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:

- Calendar Functions
- Time of day scheduling
- Holiday Scheduling
- Optimal Start
- Optimal Stop
- Demand Limiting
- Load Rolling
- Heating / Cooling Interlock
- Trending
- Alarm monitoring and routing
- Time synchronization
- Integration of LonWorks controller data and BACnet controller data
- Network Management functions for all LonWorks and/or BACnet based devices

The Network Area Controller shall provide the following hardware features as a minimum:

- One Ethernet Port – 10/100/1000 Mbps
- One RS-232 port
- One LonWorks Interface Port – 78KB FTT-10A if Lon controllers are used and/or
  One RS-485 port if BACnet controllers are used.
- Battery Backup
- Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
- The NAC must be capable of operation over a temperature range of 32 to 122°F
- The NAC must be capable of withstanding storage temperatures of between 0 and 158°F
- The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.

Event Alarm Notification and actions

- The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
- The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network, or remote via dial-up telephone connection or wide-area network.
- Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:
  - In alarm
  - Return to normal
  - Fault condition
  - Provide for the creation of a minimum of eight alarm classes for the purpose of routing types and/or classes of alarms, i.e.: security, HVAC, Fire, etc.
  - Provide timed (schedule) routing of alarms by class, object, group, or node.

    - Provide alarm generation from binary object "runtime" and/or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

Controller and network failures shall be treated as alarms and annunciated.

Alarms shall be annunciated in any of the following manners as defined by the user:

- Screen message text: All alarm or point change reports shall include the English language description of each point and the time and date of the occurrence.
- The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided.
- Users shall have the ability to manually inhibit alarm reporting for each point.The user shall also be able to define conditions under which point changes need to be acknowledged by an operator and/or logged for analysis at a later date.
- Each supervisory controller shall be capable of storing a library of at least 100 messages. Each message may be assignable to any number of points in the panel.
- Email of the complete alarm message to multiple recipients via the owner's e-mail service. Provide the ability to route and email alarms based on:
    - Day of week
    - Time of day
    - Recipient
    - Pagers via paging services that initiate a page on receipt of email message via the owner's e-mail service
    - Graphic with flashing alarm object(s)
    - Printed message, routed directly to a dedicated alarm printer

The following shall be recorded by the NAC for each alarm (at a minimum):

- Time and date
- Location (building, floor, zone, office number, etc.)
- Equipment (air handler #, access way, etc.)
- Acknowledge time, date, and user who issued acknowledgement.
- Number of occurrences since last acknowledgement.

Alarm actions may be initiated by user defined programmable objects created for that purpose.

Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

Provide a "query" feature to allow review of specific alarms by user defined parameters.

A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

Supervisory controllers shall be able to execute configured processes defined by the user to automatically perform calculations and control routines. It shall be possible to use any of the following in a configured process:

- Any system-measured point data or status
- Any calculated data
- Any results from other processes

- Boolean logic operators (and, or)
- Configured processes may be triggered based on any combination of the following:
- Time of day
- Calendar date
- Other processes
- Events (e.g., point alarms)

A single process shall be able to incorporate measured or calculated data from any and all other ASC's.

A single process shall be able to issue commands to points in any and all other programmable controllers and ASC's on the local network.

2.7. DATA COLLECTION AND STORAGE

The NAC shall have the ability to collect data for any property of any object and store this data for future use.

The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:

- Designating the log as interval or deviation.
- For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
- For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
- For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
- Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.

All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

All log data shall be available to the user in the following data formats:

- HTML (deal breaker)
- XML (deal breaker)
- Plain Text
- Comma or tab separated values
- PDF

The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:

- Archive on time of day
- Archive on user-defined number of data stores in the log (buffer size)
- Archive when log has reached its user-defined capacity of data stores
- Provide ability to clear logs once archived

Measured and calculated analog and binary data shall be assignable to user definable trends for the purpose of collecting operator specified performance data over extended periods of time. Sample intervals of 1 minute to 24 hours, in one minute or one hour intervals, shall be provided. Each supervisory controller shall have a dedicated buffer for trend data and shall be capable of storing 16 trend logs. Each trend log shall have up to four points trended at 48 data samples each. Data shall be stored at the supervisory controller and up-loaded to the DDC system server when archiving is desired.

Supervisory controllers shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis, user defined, for user-selected analog and binary pulse input type points.

Totalization shall provide calculation and storage accumulations of up to 9,999,999 units (e.g., KWH, gallons KBTU, tons, etc.).
The totalization routine shall have a sampling resolution of one minute.
The user shall have the ability to define a warning limit. Unique, user specified messages shall be generated when the limit is reached.
The information available from pulse totalization shall include, but not be limited to, the following:

- Peak demand, with date and time stamp
- 24-hour demand log
- Accumulated KWH and therms for day
- Sunday through Saturday KWH and therm usage
- Demand KW annual history for past 12 periods
- KWH and therm annual history for past periods

Supervisory controllers shall have the ability to count events, such as the number of times a pump or fan system is cycled on and off.

The event totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.

2.8. AUDIT LOG

Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:

- Time and date
- User ID
- Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

2.9. DATABASE BACKUP AND STORAGE

The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.

Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.

The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.10. ADVANCED UNITARY CONTROLLER

The controller platform shall be designed specifically to control HVAC – ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes: constant volume air handlers, VAV air handlers, packaged RTU, heat pumps, unit vents, fan coils, natural convection units, and radiant panels. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara AX Framework™, that allow standard and customizable control solutions required in executing the "Sequence of Operation" as outlined in Section 4.

Minimum Requirements:
The controller shall be capable of either integrating with other devices or stand-alone operation.
The controller shall have an FTT transformer-coupled communications port interface for common mode-noise rejection and DC isolation.
The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.

- Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
- Accuracy: ±1 minute per month at 77° F (25° C).
- Power Failure Backup: 24 hours at 32° to 122° F (0° to 50° C).

- The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
- The controller shall have an internal DC power supply to power external sensors.Power Output: 20 VDC ±10% at 75 mA.
- The controller shall have a visual indication (LED) of the status of the devise:
  - Controller operating normally.
  - Controller in process of download.
  - Controller in manual mode under control of software tool.
  - Controller lost its configuration.
  - No power to controller, low voltage, or controller damage.
  - Processor and/or controller are not operating.
- The minimum controller Environmental ratings
  - Operating Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).
  - Storage Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).
  - Relative Humidity: 5% to 95% non-condensing.
- The controller shall have the additional approval requirements, listings, and approvals:
  - UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
  - CSA (LR95329-3) Listed
  - Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
  - Meets Canadian standard C108.8 (radiated emissions).
  - Conforms to the following requirements per European Consortium standards:
    EN 61000-6-1; 2001 (EU Immunity)
    EN 61000-6-3; 2001 (EU Emissions)

The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).

The controller shall have sufficient on-board inputs and outputs to support the application.
Analog outputs (AO) shall be capable of being configured to support 0-10 V, 2-10 V or 4-20 mA devices.
Triac outputs shall be capable of switching 30 Volts at 500 mA.
Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring. Input and Output wiring terminals shall be designated with color coded labels.
Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).

The controller shall provide for "user defined" Network Variables (NV) for customized configurations and naming using Niagara AX Framework™.
- The controller shall support 62 Network Variables with a byte count of 31 per variable.
- The controller shall support 1,922 separate data values.

The controller shall provide "continuous" automated loop tuning with an Adaptive Integral Algorithm Control Loop.

The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section 4.
- Discharge air control and low limit
- Pressure-dependent dual duct without flow mixing.
- Variable air volume with return flow tracking.

- Economizer with differential enthalpy.
- Minimum air flow coordinated with CO2.
- Unit ventilator cycle (1,2,3) 2-pipe.
- Unit ventilator cycle (1,2,3) 2-pipe with face/bypass.

2.11. ADVANCED VARIABLE AIR VOLUME CONTROLLER

The controller platform shall be designed specifically for room-level VAV control – pressure-independent air flow control, temperature, and emergency control. Equipment includes: VAV terminal unit with reheat, The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara AX Framework™, that allow standard and customizable control solutions required in executing the "Sequence of Operation" as outlined in Section 4.

Minimum Requirements:

- The controller shall be capable of either integrating with other devices or stand-alone room-level control operation.
- The controller shall have an internal velocity pressure sensor.
  - Sensor Type: Microbridge air flow sensor with dual integral restrictors.
  - Operating Range: 0 to 1.5 in. H2O (0 to 374 Pa).
  - Accuracy: ±2% of full scale at 32° to 122° F (0° to 50° C); ±1% of full scale at null pressure.
- The controller shall have an FTT transformer-coupled communications port interface for common mode-noise rejection and DC isolation.
- The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
  - Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
  - Accuracy: ±1 minute per month at 77° F (25° C).
  - Power Failure Backup: 24 hours at 32° to 122° F (0° to 50° C).
- The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
- The controller shall have an internal DC power supply to power external sensors.Power Output: 20 VDC ±10% at 75 mA.
- The controller shall have a visual indication (LED) of the status of the devise:
  - Controller operating normally.
  - Controller in process of download.
  - Controller in manual mode under control of software tool.
  - Controller lost its configuration.
  - No power to controller, low voltage, or controller damage.
  - Processor and/or controller are not operating.
- The minimum controller Environmental ratings:
  - Operating Temperature Ambient Rating: 32° to 122° F (0° to 50° C).
  - Storage Temperature Ambient Rating: -40° to 122° F (-40° to 50° C).
  - Relative Humidity: 5% to 95% non-condensing.
- The controller shall have the additional approval requirements, listings, and approvals:
  - UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
  - CSA (LR95329-3) Listed
  - Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
  - Meets Canadian standard C108.8 (radiated emissions).
  - Conforms to the following requirements per European Consortium standards:
    EN 61000-6-1; 2001 (EU Immunity)
    EN 61000-6-3; 2001 (EU Emissions)
- The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).
- The controller shall provide an integrated actuator option.
  - Actuator type: Series 60 Floating.

    - Rotation stroke: 95° ±3° for CW or CCW opening dampers.
    - Torque rating: 44 lb-in. (5 Nm).
    - Run time for 90° rotation: 90 seconds at 60 Hz.
- The controller shall have sufficient on-board inputs and outputs to support the application.
    - Analog outputs (AO) shall be capable of being configured to support 0-10 V, 2-10 V or 4-20 mA devices.
    - Triac outputs shall be capable of switching 30 Volts at 500 mA.
    - Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring. Input and Output wiring terminals shall be designated with color coded labels.
    - Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).
- The controller shall provide for "user defined" Network Variables (NV) for customized configurations and naming using Niagara AX Framework™.
    - The controller shall support a range of Network Variables to 62 with a byte count of 31 per variable.
    - The controller shall support 1,922 separate data values.
- The controller shall provide continuous automated loop tuning with an Adaptive Integral Algorithm Control Loop.
- The controller shall have a loop execution response time of 1 second.
- The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section 4.
    - VAV terminal unit.
    - TOD occupancy sensor stand-by setpoints

2.12. GRAPHICAL USER INTERFACE SOFTWARE

Operating System: GUI shall be web-based (computer with browser supplied by owner) and capable of running of Windows Operating systems XP, Vista and 7 professional.

The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimal knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:

- Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of, a graphic background the GUI shall support the use of scanned pictures.
- Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
- Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
- Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
    - Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
    - Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.
- Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No text entry shall be required.
- Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No text entry shall be required.

System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

- Create, delete, or modify control strategies.
- Add or delete objects to the system.
- Tune control loops through the adjustment of control loop parameters.
- Enable or disable control strategies.
- Generate hard copy records or control strategies on a printer.
- Select points to be alarmable and define the alarm state.
- Select points to be trended over a period of time and initiate the recording of values automatically.

On-Line Help. Provide a context sensitive on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for the currently displayed screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off the system if no keyboard or mouse activity is detected for a specified time. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

Alarm Console

- The system shall be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console may be enabled or disabled by the system administrator.
- When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and unacknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

2.13. WEB BROWSER CLIENTS

The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Google Chrome or Mozilla Firefox. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall not be acceptable.

The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface (if used). Systems that require different graphic views, different means of graphic generation, or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

The Web browser client shall support at a minimum, the following functions:

- User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
    - Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
    - HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
- Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
- Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
- Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
- Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
- Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
- Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
- Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No text entry shall be required.
- View logs and charts
- View and acknowledge alarms
- Setup and execute SQL queries on log and archive information
- The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to set a specific home page for each user. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
- Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.14. SERVER FUNCTIONS AND HARDWARE

A server is provided by the owner. The contractor will enable access to and from the server.

2.15. SYSTEM CONFIGURATION TOOL

The Workstation Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.

A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.

Programming Methods

- Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
- Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
- The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
- All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.
- The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.16. LonWorks NETWORK MANAGEMENT

The Graphical User Interface software (GUI) shall provide a complete set of integrated LonWorks network management tools for working with LonWorks networks. These tools shall manage a database for all LonWorks devices by type and revision, and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between LonWorks devices, known as "binding". Systems requiring the use of third party LonWorks network management tools shall not be accepted.

Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.

The network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.

These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.

The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times, within the control system, shall not be accepted.

2.17. LIBRARY

A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

All control objects shall conform to the control objects specified in the BACnet specification.

The library shall include applications or objects for the following functions, at a minimum:

- Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.
- Calendar Object. . The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.
- Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals
- Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.
- Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.
- Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.

- Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
- Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.
- Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the

hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.

- Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.
- PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.
- Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.
- Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
- Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.
- Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.
- Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.
- Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphical shell of this container.

The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). At a minimum, provide the following as part of the standard library included with the programming software:

- LonMark/LonWorks devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. All network variables defined in the LonMark profile shall be supported. Information (type and function) regarding network variables not defined in the LonMark profile shall be provided by the device manufacturer.
- For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device

manufacturer. Device manufacturer shall provide an XIF file, resource file and documentation for the device to facilitate device integration.

- For BACnet devices, provide the following objects at a minimum:
  - Analog In
  - Analog Out
  - Analog Value
  - Binary
  - Binary In
  - Binary Out
  - Binary Value
  - Multi-State In
  - Multi-State Out
  - Multi-State Value
  - Schedule Export
  - Calendar Export
  - Trend Export
  - Device
- For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.
- For BACnet devices, provide the following support at a minimum
  - Segmentation
  - Segmented Request
  - Segmented Response
  - Application Services
  - Read Property
  - Read Property Multiple
  - Write Property
  - Who-has
  - I-have
  - Who-is
  - I-am
  - Media Types
  - Ethernet
  - BACnet IP Annex J
  - MSTP
  - BACnet Broadcast Management Device (BBMD) function
  - Routing

2.18. DDE DEVICE INTEGRATION

The Network Area Controller shall support the integration of device data via Dynamic Data Exchange (DDE), over the Ethernet Network. The Network Area Controller shall act as a DDE client to another software application that functions as a DDE server.

Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of these devices into the FMCS. Objects provided shall include at a minimum:

- DDE Generic AI Object
- DDE Generic AO Object
- DDE Generic BO Object
- DDE Generic BI Object

2.19. MODBUS SYSTEM INTEGRATION

The Network Area Controller shall support the integration of device data from Modbus RTU, ASCII, or TCP control system devices. The connection to the Modbus system shall be via an RS-232, RS485, or Ethernet IP as required by the device.

Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the Modbus system data into the FPMS. Objects provided shall include at a minimum:

- Read/Write Modbus AI Registers
- Read/Write Modbus AO Registers
- Read/Write Modbus BI Registers
- Read/Write Modbus BO Registers

All scheduling, alarming, logging and global supervisory control functions, of the Modbus system devices, shall be performed by the Network Area Controller.

The FMCS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment utilizing Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning

2.20. OPC SYSTEM INTEGRATION

The Network Area Controller shall act as an OPC client and shall support the integration of device data from OPC servers. The connection to the OPC server shall be Ethernet IP as required by the device. The OPC client shall support third party OPC servers compatible with the Data Access 1.0 and 2.0 specifications.

Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the OPC system data into the BAS. Objects provided shall include at a minimum:

- Read/Write OPC AI Object
- Read/Write OPC AO Object
- Read/Write OPC BI Object
- Read/Write OPC BO Object
- Read/Write OPC Date/Time Input Object
- Read/Write OPC Date/Time Output Object
- Read/Write OPC String Input Object
- Read/Write OPC String Output Object

All scheduling, alarming, logging and global supervisory control functions, of the OPC system devices, shall be performed by the Network Area Controller.

The FMCS supplier shall provide an OPC client communications driver. The equipment system vendor that provided the equipment utilizing OPC shall provide documentation of the system's OPC server interface and shall provide factory support at no charge during system commissioning.

2.21. GRAPHICAL USER INTERFACE COMPUTER HARDWARE (DESKTOP)

Will be provided by owner.

Contractor shall provide 2 network ports in or near mechanical room. Exact location to be provided by owner on site.

2.22. OTHER CONTROL SYSTEM HARDWARE

Space Temperature Wall Module: Temperature sensing modules mounted on the wall in occupied spaces. Optional setpoint, indication, and override switches must be provided as specified.

- Manufacturers:
  - Alerton
  - ACI
  - Honeywell
  - Johnson Controls
  - Novar
  - Siemens Building Technologies
  - Trend

- Wall module shall have a thermistor temperature sensor with operating range of 25 to 99 deg. F. under a locking cover/enclosure designed for mounting on a standard electrical switch box.
- Space temperature sensors shall be accurate to plus or minus 0.5 deg. F at 77 deg. F.
- Where specified, space temperature sensors shall have a setpoint knob calibrated for warmer-cooler adjustments and shall be calibrated to allow plus or minus adjustments to a software setpoint and to allow absolute setpoint changes.
- Where specified, wall module shall also have an after-hours override pushbutton and LED override indicator.
- Where specified, the wall module shall have a fan coil unit fan control switch for auto-off-on or auto-off-low-med-hi fan control (depending fan equipment speed options) . The wall module function is further specified in SECTION III Sequence of Operation.
- Where specified, wall module shall have an LCD display with 2 level user access. Level one access shall be available for typical occupant adjustments, and level two access for system configuration. Level two access shall be accessible only via password or multi-key code input. Room temperature, room temperature setpoint, VAV balancing parameters and settings, occupancy override, and other control parameters for a total of at least 35 items shall be available via the keypad/display. Wall module screens shall be configurable for typical tenant and control contractor views.

Duct Mount, Pipe Mount, and Outside Air Temperature Sensors:

- Manufacturers:
  - Alerton
  - ACI
  - Honeywell
  - Johnson Controls
  - Novar
  - Siemens Building Technologies
  - Trend
- Outside air sensors shall include an integral sun shield.
- Temperature sensors shall have an accuracy of plus or minus 1.0 deg. F. over operating range.
- Duct sensors shall have sensor approximately in center of the duct, and shall have selectable lengths of 6, 12, and 18 inches.
- Multipoint averaging element sensors shall be provided where specified, and shall have a minimum of one foot of sensor length for each square foot of duct area (provide multiple sensors if necessary).
- Pipe mount sensors shall have copper, or stainless steel separable wells.

Current Switches: Solid state, split core, current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point shall be provided where specified. Current switches shall include an integral LED for indication of trip condition.

- Manufacturers:
  - ACI
  - Honeywell
  - RIB, Inc.
  - Veris Industries

- Sensing range 0.5 – 250 Amps.
- Output 0.3 A @ 200 VAC/VDC / 0.15 A @ 300 VAC/VDC
- Operating frequency 40 Hz -1 kHz.
- Operating Temperature 5-104 deg. F (-15 – 40 deg. C), Operating Humidity 0-95% non-condensing
- Approvals CE, UL.

Current Sensors: Solid state, split core linear current sensors shall be provided where specified.

- Manufacturers:
  - ACI
  - Honeywell
  - RIB, Inc.
  - Veris Industries
- Linear output of 0-5 VDC, 0-10 VDC, or 4-20 mA.
- Scale sensors so that average operating current is between 20-80% full scale.
- Accuracy plus or minus 1.0% (5-100% full scale)
- Operating frequency 50-600 Hz.
- Operating Temperature 5-104 deg. F (-15 – 40 deg. C), Operating Humidity 0-95% non-condensing
- Approvals CE, UL.

Low Temperature Limit Switches: Safety low limit shall be non-averaging manual reset twenty foot limited fill type.

- Manufacturers:
  - Honeywell
  - Johnson Controls
  - Siemens Building Technologies
  - TAC
- Low Limit Setpoint shall be adjustable between 20 and 60 deg. F. (-5 and 15 deg. C.)
- Switch enclosure shall be dustproof and moisture-proof.
- Switch shall break control circuit on temperature fall. Contact ratings shall be 10.2 FLA at 120 VAC, and 6.5 FLA at 240 VAC.
- Ambient Temperature range -20 to 125 deg. F. (-11 to 52 deg. C.)
- Operating Temperature Range 20 to 60 deg. F. (-5 to 15 deg. C.)

Carbon Monoxide (CO) Sensors:

- Manufacturers:
  - Honeywell
  - ACI
  - Approved equal

- Carbon Monoxide sensors shall be 2-10 Vdc, or 4-20 mA linear analog output type, wide spectrum electrochemical sensor, designed for duct or wall mounting.
- Sensor shall have a factory set operating range of 0-6 ppm with accuracy +/- 2.5% of reading, repeatability +/- 1.0% of reading.
- Sensor shall have an LCD display that displays the sensor reading and status.
-

Nitrogen Dioxide (NO2) Sensors:

- Manufacturers:
  - Honeywell
  - ACI
  - Approved equal

- Nitrogen dioxide sensors shall be 2-10 Vdc, or 4-20 mA linear analog output type, wide spectrum electrochemical sensor, designed for duct or wall mounting.

- Sensor shall have operating range of 0-125 ppm with accuracy +/- 2.5% of reading, repeatability +/- 1.0% of reading.
- Sensor shall have an LCD display that displays the sensor reading and status.

Differential Pressure Sensors:

- Manufacturers:
  - ACI
  - Honeywell
  - RIB, Inc.
  - Veris Industries
- Sensor shall have four field selectable ranges: 0.1, 0.24, 0.5, 1.0 in w.c. for low pressure models, and 1.0, 2.5, 5, 10 for high pressure models.
- Sensor shall provide zero calibration via pushbutton or digital input.
- Sensor shall have field selectable outputs of 0-5 VDC, 0-10 VDC, and 4-20 mA
- Where specified, sensor shall have and LCD display that displays measured value.
- Sensor overpressure rating shall be 3 PSID proof, and 5 PSID burst.
- Sensor accuracy shall be plus or minus 1% FS selected range.

Humidity Sensors:

- Manufacturers:
  - Honeywell
  - Johnson Controls
  - Siemens Building Technologies
  - TAC
- Humidity transducer shall be accurate to +/- 2% between 20-95% RH NIST traceable calibration.
- Sensors shall have a field selectable output of 0-10 Vdc, 0-5 Vdc, or 4-20 mA.
- Sensors shall provide field calibration option using non-interacting zero and span potentiometers, and/or toggle switches that increment or decrement the RH value in steps of 0.5% RH.
- Accuracy of the sensor shall not be adversely affected by condensation.

Low Leakage Automatic Control Dampers: Provide all automatic control dampers not specified to be integral with other equipment.

- Manufacturers:
  - Greenheck
  - Honeywell
  - Johnson Controls
  - Ruskin
- Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the air stream.
- Blades shall not be over 8 inches wide or less than 16-gauge galvanized steel triple V type for rigidity.
- Bearings shall be acetyl, oilite, nylon or ball-bearing with ½ inch diameter plated steel shafts.
- Dampers shall be suitable for temperature ranges of -40 to 180F.
- All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.
- Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6". Dampers with dimensions of 24 inches and less shall be rated for 3,000 fpm velocity and shall withstand a maximum system pressure of 5.0 in. w.c. Dampers with dimensions of 36 inches and less shall be rated for 2,500 fpm velocity and shall withstand a maximum system pressure of 4.0 in. w.c. Dampers with dimensions of 48 inches and less shall be rated for 2,000 fpm velocity and shall withstand a maximum system pressure of 2.5 in. w.c.
- Side seals shall be stainless steel of the tight-seal spring type.
- Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage data for all low leakage control dampers with the temperature control submittal.

- Maximum leakage for low leakage dampers in excess of sixteen inches square shall be 8 CFM per square foot at static pressure of 1 inch of WC.
- Low leakage damper blade edges shall be fitted with replaceable, snap-on, inflatable seals to limit damper leakage.
- Testing and ratings shall be in accordance with AMCA Standard 500.
- Damper blade width shall be no greater than 8 inches, and dampers over 48 inches wide by 74 inches high shall be sectionalized. Testing and ratings to be in accordance with AMCA Standard 500.

Control Valves (Globe Type): Control valves shall be 2-way or 3-way pattern as shown constructed for tight shutoff and shall operate satisfactory against system pressures and differentials.

- Manufacturers:
  - Honeywell
  - Johnson Controls
  - Siemens Building Technologies
  - TAC
- Proportional control valves shall be sized for a nominal pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Manufacturer's specified maximum differential pressure shall not be exceeded in order to prevent cavitation.
- Two-way proportional valves shall have equal percentage flow characteristics. Three-way valves shall have equal percentage flow characteristics straight through, and linear through the bypass. Rangeability shall be 50:1 or greater.
- Provide valve position indicator and a method to operate valves manually during system start-up, or actuator power loss or failure on all valves.
- Leakage rate shall be no more than ANSI Class III (for heating) or ANSI Class IV (for cooling).
- Valves 1/2 inch through 3 inches shall be screwed pattern except where solder connections are specified for valves 1/2 or 3/4 inches.
- Three-way valve bypass ports shall be of Cv to provide constant flow through the control loop.
- Two-way valves shall close off against the net differential pressure resulting from the maximum head pressure of the system pumps less all loop pressure losses. Three-way valves shall close off against the difference in head pressure between the controlled load and the bypass line.
- Valves 2-1/2 inch and larger shall be flanged and ANSI/ASME-rated to withstand the pressures and temperatures specified.
- Valves shall have stainless-steel stems and spring loaded Teflon packing with replaceable discs.

Control Valves (Characterized Ball Valves): Control valves 1/2 to 3 inches shall be 2-way or 3-way forged brass screwed pattern constructed for tight shutoff and shall operate satisfactory against system pressures and differentials.

- Manufacturers:
  - Honeywell
  - Johnson Controls
  - Siemens Building Technologies
  - TAC
  - Griswold Controls

- Proportional control valves shall be sized for a nominal pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Manufacturer's specified maximum differential pressure shall not be exceeded in order to prevent cavitation.
- Two-way proportional valves shall have equal percentage flow characteristics. Three-way valves shall have equal percentage flow characteristics straight through and linear flow through the bypass.
- Leakage rate shall be ANSI Class IV (no more than 0.01% of Cv).
- Fluid temperature range shall be between -22 and +250 degrees F. water or glycol solutions up to 50%. Piping and valves shall be properly insulated to prevent formation of ice on moving parts.
- Valves shall be rated for no less than 360 psig at 250 degrees F.

- Provide a method to operate valves manually during system start-up, or actuator power loss or failure on all valves.
- Two-way valves shall close off against 70 psi minimum, and three-way valves shall close off against 40 psi minimum.
- Valves shall have stainless-steel or chemically nickel-plated brass stem and throttling port.
- Actuator shall be available with NEMA 3R (IP54) rated enclosure suitable for outdoor installation.
- Valves shall be tagged with Cv rating and model number.

Variable Frequency Drives:

- Manufacturers:
  - ABB
  - Danfoss
  - Honeywell
  - Siemens Building Technologies
- Submit shop drawings Submit shop drawings for all VFD and associated system components as herein specified including all data concerning dimensions, capacities and performance, wiring diagrams and appropriate identification. Submit certified efficiency versus load and speed curves for VFD. Submit certified electrical noise generation data in accordance with IEEE 519 standard. Submit electrical noise attenuation equipment required to meet criteria specified.
- Variable frequency drives shall be UL listed and sized for the power and loads applied.
- Drives shall include built-in radio frequency interference (RFI) filters and be constructed to operate in equipment rooms and shall not be susceptible to electromagnetic disturbances typically encountered in such environments. Similarly, the drives must not excessively disturb the environment within which it is used.
- All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD enclosure shall be NEMA 1, freestanding or wall mounted.
- The VFD shall convert three-phase, 60-Hz utility power to adjustable-voltage and frequency, three-phase power for stepless motor speed control from 5% to 100% of the motor's 60-Hz speed. Input voltage shall be as specified on the Drawing schedules.
- The VFD shall include a converter and an inverter section. The converter section shall convert fixed frequency and voltage AC utility power to DC voltage. All VFDs shall include input line reactors.
- The VFD shall employ a full wave bridge rectifier and capacitors to minimize the ripple of the rectified voltage to maintain near constant DC voltage. Insulated gate bipolar transistors (IGBT's) shall be employed as the output switching device.VFD shall use solid state, micro processor-based with a pulse width modulated (PWM) output wave form (none others are acceptable).
- The inverter section of the VFD shall invert the DC voltage into a quality output waveform, with adjustable voltage and frequency for stepless motor speed control.
- The VFD and options shall be tested to ANSI/UL Standard 508. The Complete system, including all specified options, shall be listed by a nationally recognized testing agency such as UL or BTL.
- Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in IEEE Standard 519-1981, Guide for Harmonic Control and Reactive Compensation of Static Power Converters. The total voltage distortion shall not exceed 5%.
- The VFD shall not emit radiated RFI in excess of the limitations set forth in the FCC Rules and Regulations, Part 15 for Class A computing devices. The VFD shall carry a FCC compliance label. PWM type drives shall include RFI filters.
- The VFD shall not cause objectionable acoustical motor noise. Motor noise as a result of the VFD shall be limited to three dB-over across-the-line operation, measured at three feet from the motors center line.
- The VFD's full load AMP rating shall meet or exceed NEC Table 430-150.
- Motors and variable frequency drives shall be provided by the drive manufacturer and selected to accommodate additional motor heating when driven by a VFD, while maintaining full nameplate horsepower at specified service factor.
- VFD system shall modulate the speed of its respective motor in response to a 0-10 VDC or 4-20 mA control signal provided by the Temperature Control Sub-contractor.

- VFD shall be variable torque, solid state transistorized control with diode bridge rectifier and manual transfer switch. The unit shall be U.L. listed, solid state, micro processor-based with a pulse width modulated (PWM) output wave form (none others are acceptable). The VFD shall employ a full wave bridge rectifier, to prevent line notching, with DC output bus choke, capacitors to minimize the ripple of the rectified voltage to maintain near constant DC voltage. Insulated gate bipolar transistors (IGBT's) shall be employed as the output switching device. VFD shall be factory tested at maximum HP and 40 deg. C for 100 hours.
- Performance:
    - Minimum Efficiency: 92% @ 50%; 99% @ 100% speed.
    - Power Factor: 0.95 through speed range.
    - Adjustments: Minimum and maximum speed acceleration-deceleration 30 to 50 seconds.
    - Power Line Noise: Voltage distortion factor of 5% or less and a line notch depth of 25% or less.
    - Ride through a momentary power outage of 15 cycles,
    - Start into a rotating load without damage to drive components or motor,
    - Capable of automatic restart into a rotating load after a preset, adjustable time delay following a power outage
    - Units shall be suitable for input power of electrical system as scheduled on the drawings ±10%, 3 phase, 60 Hertz nominal.
    - Use a current limiting control device to limit output current to 110% continuous for one minute; also refer to Protection Features in this section. Full load output current available from drive shall not be less than motor nameplate amperage. The full load amp rating of the VFD shall not be less than the values indicated in the NEC Table 430-150.
    - Output power shall be suitable for driving standard NEMA B design, three phase alternating current induction motors at full rated speed with capability of 20:1 turndown.
- Features:
- Run/stop selector switch, auto/manual selector switch, fault light, manual speed potentiometer, power on light, ready light.
- Speed/power/load digital display and selector switch.
- Automatic under voltage reset with adjustable time delay.
- 0-10 VDC or 4-20 mA common input signal follower.
- Motor overload protection.
- Over temperature protection.
- Under voltage/over voltage protection.
- Adjustable current limit. Input disconnect switch, not required if existing starter and disconnect reused.
- Local speed control at the VFD
- Adjustable acceleration and deceleration rate so that the time period from start to full speed and from full speed to stop can be field adjustable.
- Adjustable minimum and maximum speed settings for both automatic and manual modes of operation
- Field adjustment of minimum and maximum output frequency
- Two (2) sets of programmable form "C" contacts for remote indication of variable frequency drive condition. Note: default programming to be set for "Drive Run & Fault".
- Illuminated display keypad.
- External Fault indicator
- One (1) input for a N.O. dry contact type input for a 2-wire remote start/stop
- One (1) input for a N.C. dry contact type input for external faults: (freezestats, fire alarm, smokes, etc). This input shall be factory wired to prevent both the VFD and bypass starter operation when external fault is present.
- One (1) N.O. dry contact output for proving motor status. This output shall be programmed to detect belt or coupling break that would remove the load from the motor. The dry contact will open on loss of load or VFD being off.
- Diagnostics: Provide an English character display (no error codes) with indicators for the following:
    - Phase loss

    - Ground fault
    - Overcurrent
    - Over-voltage
    - Under-voltage
    - Over temperature
    - Overload
    - DC bus status
- All VFDs over 3 horsepower shall be provided with an AC choke.
- VFDs shall be installed in strict conformance to the manufacturer's installation instructions, and shall be rated to operate over a temperature range of 14 to 104 F.
- VFD automatic operation shall be suitable for an analog input signal compatible with the digital controller output.
- Each VFD shall be fan cooled and have an integral keypad and alphanumeric display unit for user interface. The display shall indicate VFD status (RUN motor rotation, READY, STOP, ALARM, and FAULT), and shall indicate the VFD current control source (DDC input signal, keypad, or field bus control). In addition to the alphanumeric display, the display unit shall have three pilot lights to annunciate when the power is on (green), when the drive is running (green, blinks when stopping and ramping down), and when the drive was shut down due to a detected fault (red, fault condition presented on the alphanumeric display).
- Three types of faults shall be monitored, "FAULT" shall shut the motor down, "FAULT Auto-reset" shall shut the motor down and try to restart it for a programmable number of tries, and "FAULT Trip" shall shut the motor down after a FAULT Auto-reset fails to restart the motor. Coded faults shall be automatically displayed for the following faults:
    - Over current
    - Over voltage
    - Earth ground
    - Emergency stop
    - System (component failure)
    - Under voltage
    - Phase missing
    - Heat sink under temperature
    - Heat sink over temperature
    - Motor stalled
    - Motor over temperature
    - Motor under load
    - Cooling fan failure
    - Inverter bridge over temperature
    - Analog input control under current
    - Keypad failure
    - Other product unique monitored conditions
- In addition to annunciating faults, at the time of fault occurrence the VFD shall capture and make available to the user certain system data for subsequent analysis during fault trouble shooting, including duration of operation (days, hours, minutes, seconds),output frequency, motor current, motor voltage, motor power, motor torque, DC voltage, unit temperature, run status, rotation direction, and any warnings. The last 30 fault occurrences shall be retained as well as the fault data listed in the previous sentence of each fault. New faults beyond 30 shall overwrite the oldest faults.
- The display unit keypad shall allow setting operational parameters including minimum and maximum frequency, and acceleration and deceleration times. The display shall offer user monitoring of frequency, unit temperature, motor speed, current, torque, power, voltage, and temperature.

Actuators, General: All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close-off. Valves shall be provided with actuators suitable for floating or analog signal control as required to match the controller output. Actuators

shall be power failure return type where valves or dampers are required to fail to a safe position and where specified. Actuators shall be chosen based on torque requirement of the device controlled and allow for 10% additional torque:

Non-Spring Return Low Torque Direct Coupled 35 & 70 lb-in Actuators: Actuators shall be 35 or 70 lb-in. with strokes adjustable for 45, 60, or 90 degree rotation applications and designed for operation between 20 and 125 F.

- Manufacturers:
  - Honeywell
  - Johnson Controls
  - Siemens Building Technologies
  - TAC
- Each actuator shall also have a minimum position adjustable rotation of 0 to 30 degrees.
- Actuators shall be for floating or two position (ML 6161 or ML6174) control, or for 4-20 mA or 2-10Vdc (ML7161 or ML7174) input signals.
- Analog control actuators shall have a cover mounted direct/reverse acting switch.
- Actuator motor shall be magnetically coupled or shall have limit switch stops to disengage power at the ends of the stroke.
- Actuators shall be direct connected (no linkages) and provided with a manual declutch for manual positioning.
- Actuators shall have NEMA 1 environmental protection rating and be 24 volt and UL listed with UL94-5V plenum requirement compliance.
- Minimum design life of actuators shall be for 1,500,000 repositions and 35 lb-in. models shall be designed for 50,000 open-close cycles and 70 lb-in. models shall be designed for 40,000 open-close cycles.
- Actuator options shall include 1) Auxiliary feedback potentiometers, 2) open-closed indicator switches, 3) actuator timings of 90 seconds, 3 minutes, or 7 minutes, one or two auxiliary switches, and 4) torque of 35 or 70 lb-in.

Non-Spring Return High Torque 177 and 300 lb-in Actuators: Actuators shall be UL listed 24 Vac in NEMA 2 enclosures designed for operation between -5 and 140 F.

- Manufacturers:
  - Honeywell
  - Johnson Controls
  - Siemens Building Technologies
  - TAC
- Rotation direction shall be switch selectable.
- Minimum design life of actuators shall be for 1,500,000 repositions and for 60,000 open-close cycles.
- Actuators shall be suitable for the controller output signals encountered, floating or analog, and shall have full cycle timing of 95 seconds.
- Actuators shall be direct connected (no linkages) and provided with a manual declutch for manual positioning. Actuators shall be chosen based on torque requirement of the device controlled and allow for 10% additional torque:
- Actuators shall have 300 lb-in. torque with adjustable stroke, 30 to 90 degrees, and shall auxiliary end switches to annunciate full open and full closed positions.
- Actuators shall have 177 lb-in. torque with adjustable stroke, 30 to 90 degrees, and shall auxiliary end switches to annunciate full open and full closed positions.

Spring Return Direct Coupled Actuators: Actuators shall have torque ratings of 44lb-in., 88 lb-in., or 175 lb-in. Actuators shall be modulating 90 seconds nominal timing or two-position 45 seconds nominal timing types with strokes for 90 degree rotation applications and designed for operation between -40 and 140 F.

- Manufacturers:
  - Honeywell
  - Johnson Controls
  - Siemens Building Technologies

- TAC

- Each torque rating group shall have optionally selected control types, floating control, 2-position 24 Vac, 2-position line voltage, or analog input which is switch selectable as 0-10Vdc, 10-0 Vdc, 2-10 Vdc, or 10-2 Vdc.
- Actuator spring return direction (open or closed) shall be easily reversed in the field, and actuators shall spring return in no greater than 20 seconds.
- Actuators shall be direct connected (no linkages), and shall have integral position indication.
- Actuators shall have NEMA 2 environmental protection rating, and UL approved and plenum rated per UL873.
- Minimum design life of modulating actuators shall be for 1,500,000 repositions and 60,000 spring returns, except 2-position actuators shall be for 50,000 spring returns.
- Each actuator shall be provided with a manual power-off positioning lever for manual positioning during power loss or system malfunctions, including a gear-train lock to prevent spring action.
- Upon power restoration after gear lock, normal operation shall automatically recur.

3. - EXECUTION

3.1. INSTALLATION

All work described in this section shall be performed by system integrators or contractors that have a successful history in the design and installation of integrated control systems. The installing office shall have a minimum of five years of integration experience and shall provide documentation in the submittal package verifying the company's experience.

Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

Drawings of the TCS and FMCS network are diagrammatic only and any apparatus not shown, but required to make the system operative to the complete satisfaction of the Architect shall be furnished and installed without additional cost.

Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by this contractor in accordance with these specifications.

Equipment furnished by the HVAC Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by this contractor.

3.2. WIRING

All wiring shall be in accordance with the Project Electrical Specifications, the National Electrical Code and any applicable local codes. All FMCS wiring shall be installed in the conduit types specified in the Project Electrical Specifications (Division 16) unless otherwise allowed by the National Electrical Code or applicable local codes. Where FMCS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

3.3. ACCEPTANCE TESTING

Upon completion of the installation, this contractor shall load all system software and start-up the system. This contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

This contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly

schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

System Acceptance: Satisfactory completion is when all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.4. OPERATOR INSTRUCTION, TRAINING

During system commissioning and at such time acceptable performance of the TCS and FMCS hardware and software has been established this contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

This contractor shall provide 40 hours of instruction to the owner's designated personnel on the operation of the TCS and FMCS and describe its intended use with respect to the programmed functions specified. Operator orientation of the systems shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

The training shall be in three sessions as follows:

- Initial Training: One day session (8 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.
- First Follow-Up Training: Two days (16 hours total) approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.
- Warranty Follow Up: Two days (16 hours total) in no less than 4 hour increments, to be scheduled at the request of the owner during the one year warranty period. These sessions shall cover topics as requested by the owner such as; how to add additional points, create and gather data for trends, graphic screen generation or modification of control routines.

4. - SEQUENCES OF OPERATION

4.1. SUMMARY

Contractor shall coordinate control functions, such as scheduling and supervisory-level global control, points list, and control sequences needed for this installation as listed below. Contractor shall provide written documentation to archive the system operation as accepted by the owner.

Control software shall include a provision for limiting the number of times that each piece of equipment may be cycled within any one-hour period.

The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

4.2. VARIABLE AIR VOLUME AIR HANDLING SYSTEMS (AHU-1 and ERV-1)

General:

- System on/off status shall be based on schedule programmed into FMCS system.
- Failure of system to start based on supply fan motor current sensor shall signal alarm.
- Activation of duct smoke detector shall shut down system signal local control panel alarm and signal fire alarm system.
- Upon activation, manual reset (35 deg. F adjustable) freeze stat shall close outside exhaust air dampers, open recirculation damper, stop supply fan and signal alarm.

- Upon receiving signal from fire alarm system, AHU shall shut down. FMS contractor shall provide contacts for receiving signal at AHU control panel and subsequent control wiring devices necessary to shut down system.
- When current switches are used for proving fan or pump status, they shall be set up so that they will detect belt or coupling loss by the reduction in current draw on loss of coupled load.

Temperature Setpoints:

- Occupied Space Terminal Unit Heating: 68° F
- Occupied Space Terminal Unit Cooling: 75° F
- Garage and Entry Way Heating: 60° F
- Unoccupied Space Terminal Unit Cooling: 82° F
- Unoccupied Space Terminal Unit Heating: 60° F

The Air Handling System consists of the following:

- Supply fan with variable speed electronically commutated motor.
- Outside air damper furnished by AHU manufacturer.
- Return air damper furnished by AHU manufacturer.
- Refrigerant coil for cooling.
- Hot water coil for heating.
- MERV 7 and MERV 11 filter banks.
- Return plenum economizer relief damper provided by T.C.C.
- Energy recovery ventilator ERV-1 with supply and exhaust fans and associated isolation dampers by equipment manufacturer.

Occupied Operation (facility is anticipated to be occupied 24/7):

- AHU fan shall operate continuously.

  Energy recovery ventilator exhaust and supply fans shall operate continuously.

Unoccupied Operation:

- Fans shall be off.
- Upon detection of a zone temperature above or below of the unoccupied setback temperature:
  - AHU fan shall start.
  - Energy recovery ventilator exhaust and supply fans shall remain off.
  - Discharge temperature sensor shall stage cooling and heating controls to maintain 65 deg F. (adj.) setpoint.
  - System shall remain on until all zone unoccupied setpoints are reached and minimum 15 (adj.) minute anti-cycling run timer is satisfied.

Supply Fan Speed Control:

- The DDC system shall modulate the supply fan to maintain the static pressure setpoint. Shut down fan and send alarm if pressure sensor reads higher than 4.0"W.C.
- The static pressure sensing probe shall be installed in the main supply duct located as shown on the plans and piped to the differential pressure transmitter. The inputs to the differential pressure transmitter shall be the static pressure inside of the duct and the reference input shall sense the actual space served by the air system.
- Static Pressure Reset Control: Static pressure setpoint shall be within the range 0.15 in. w.c. to 1.3 in. w.c. When the fan is off, the setpoint shall be reset to 0.8 in. w.c. (adj.) and this setpoint shall be used on system start up. While the fan is proven on, every two minutes, trim the setpoint by 0.04 in. w.c. if there are two or fewer zone pressure requests. If there are more than two zone pressure requests, respond by increasing the setpoint by 0.06 in. w.c.

- A zone pressure request is generated when a VAV damper is greater than 95% open until it drops to 80% open. Provide a binary data enable point for each zone to enable/disable the zone damper in the trim and respond algorithm. All setpoints, timers, and zone pressure request threshold for the static pressure reset shall be adjustable. Tune the reset to prevent cyclic instability after the space is occupied. Provide a trend graph to show the relative stability of the static pressure setpoint. Final maximum setpoint shall be determined by the Balancing Contractor to satisfy the worst case zone at maximum design condition.

Energy Recovery Ventilator Control:

- The DDC system shall open the ERV-1 Outside Air isolation damper and Exhaust damper, start ERV-1 ventilation supply air fan and exhaust fan independently. Start the supply and exhaust fan in occupied mode. When the economizer sequence is enabled (see below), the supply fan shall be disabled and the associated damper shall be commanded closed. When OA temp is 15 ° F or lower, the supply damper shall open and the supply fan shall start.
- Fixed Ventilation Air Flow Setpoint: The AHU outside air ventilation rate shall be maintained at 350 CFM via air supplied from ERV-1, or greater during economizer operation.

Air Cooled Condensing Unit Control:

- Condensing unit consists of two scroll compressors with independent refrigerant circuits. One compressor has variable capacity modulation (digital scroll or equivalent) and one has a fixed capacity.
- Upon call for cooling, the BAS shall start the variable capacity compressor and regulate capacity based on temperature setpoint. If the compressor output reaches 100% and additional cooling is required, the fixed capacity compressor shall start while the variable capacity compressor ramps down to zero. Further call for cooling will cause the variable capacity compressor to modulate back up to maintain setpoint. As cooling capacity demand drops, the sequence shall operate in reverse.
- DDC system shall monitor compressor status and permit independent compressor operation,

Discharge Air Temperature Control:

- Install a temperature sensor in the supply duct downstream of the supply fan and all water coils.

- The heating coil, return, economizer and relief dampers, and the refrigeration system shall be controlled in sequence to maintain the discharge air setpoint temperature of 55 ° F (adj.). Whenever the discharge air temperature is above the setpoint, the following shall occur in sequence: The heating coil control shall modulate closed as sequenced below. When heating is completely off and the economizer sequence is enabled, the relief damper shall open and economizer outside air damper and return air damper shall be modulated together in sequence to maintain discharge air temperature setpoint. When the economizer damper is completely open, or the economizer sequence is not enabled, the condensing unit and refrigerant coil shall maintain the discharge air temperature setpoint. When the discharge air setpoint is below setpoint the reverse shall occur. The refrigeration system shall be locked out below 50° F (adj.) outside air temperature.

- Hot Water Coil Control: Modulate the heating coil control valve as sequenced under discharge air control.

- Floating Dry Bulb Economizer Switchover: The economizer sequence shall be enabled whenever the outside air temperature is less than 4° F (adj.) cooler than the return air temperature.

Filters:

- Install a differential static pressure sensor across the filter bank. Ensure that the static probes do not impede filter removal.

- For combination pre/final filter bank, provide an alarm to the operator interface when the differential static pressure exceeds 1.0" W.C. (adj.).

4.3. TERMINAL UNITS CONTROL SEQUENCES

Radiation Control:

- Provide a zone temperature sensor to monitor room. DDC shall modulate the hot water control valve to maintain constant space temperature.

Unit Heater Control:

- Provide a zone temperature sensor to monitor room. DDC shall modulate the hot water control valve and start fan to maintain constant space temperature.

Cabinet Unit Heater Control:

- Provide a zone temperature sensor to monitor room. DDC shall modulate the hot water control valve and start fan to maintain constant space temperature.
- Provide an immersion type aquastat to de-energize the fan if return water temperature is less than 50° F.

VAV Box with Hot Water Reheat, Pressure Independent:

- Temperature Control. Zone temperature setpoint shall normally be placed in the occupied, standby, or unoccupied mode of operation and controlled via a system scheduler seven day schedule. Prior to scheduled occupied periods, the unoccupied temperature setpoint shall be ramped to the occupied setpoint over a time period proportional to the temperature difference between the room temperature and the occupied temperature setpoint such that at occupancy time the occupied temperature is reached. During unoccupied and standby periods the unoccupied and standby temperature setpoints shall be maintained. The standby mode of operation is for periods of temporary vacancy such as the lunch hour, and shall use owner determined temperature setpoints that fall between the unoccupied setpoint and the occupied setpoint. Occupied Heating, Occupied Cooling, Standby Heating, Standby Cooling, Unoccupied Heating and Unoccupied Cooling setpoint defaults shall be programmed in the controller. VAV box controls shall be enabled anytime the respective VAV AHU fan operates. Each VAV box shall have unique design minimum and maximum primary air cfm setpoints for heating and cooling. As the cooling load varies, a PID algorithm shall reset the box cfm setpoint between these min and max values to maintain the setpoint. An AIA algorithm shall modulate the box damper to maintain the cfm setpoint.
- Heating/Cooling Mode: Heating/cooling mode shall be determined by the heating/cooling demand in the space with respect to active setpoint. Heating mode shall be disabled when system heating is unavailable to eliminate overcooling the space. An adjustable deadband shall prevent the control from cycling between heating and cooling modes.
    - Cooling mode: The VAV box damper shall modulate to provide airflow between the minimum and maximum cfm setpoints proportional to the cooling demand.
    - Heating mode: The VAV box damper modulates to provide minimum air flow as the hot water valve opens. As the heating demand increases the VAV box damper modulates to provide airflow at the reheat cfm setpoint.

  Occupant Schedule Override Control. When any room HVAC system is operating in a mode other than OCCUPIED, each temperature sensor wall module (where specified) shall provide the room occupant with ability to place the system in the occupied mode of operation for 60 (180 default, user programmable) minutes by pressing the wall module override button. Via the button, the occupant shall also have the ability to cancel the override command, or to place the system in the unoccupied mode when operating in the occupied mode. Via the module LED, the occupant shall have the ability to note the status of the system overrides as being in the override mode, override unoccupied mode, continuously occupied mode via a network command, or in the normal mode of operation (LED off).

- Wall Sensor Module. Wall temperature sensor module shall be located where shown on the plans, and shall include the temperature sensor, the occupied/unoccupied override selection push button with override status LED (where specified), a warmer-cooler setpoint adjustment knob (where specified), and a jack for connecting to the LonWorks communication network. The system owner determines the normal heating and cooling room temperature setpoints for all wall module sensors (such as 73F & 77F). The warmer-cooler adjustment knob on the wall module shall give room occupants the ability to vary these values by an owner determined increment, such as two degrees, by rotating the setpoint knob. Setpoints in use when the room is unoccupied shall not be affected by the setpoint knob.

4.3. DIRECT FIRED HEATING ONLY MAKE-UP AIR UNITS:

GENERAL:
- The make-up air unit is a constant air volume, heating only, outdoor air unit.

FAN CONTROL:
- Start/Stop: The BAS system shall start the supply fan. Upon startup, the inlet air damper in the make-up air unit shall open.
- The fans shall be enabled when the inlet damper end switch contact proves the damper is open.
- Current Status Switch: Fan status shall be detected by current switch installed according to guidelines above.

FILTER:
- Install a differential static pressure sensor across the filter bank. Ensure that the static probes do not impede filter removal.
- For filter bank, provide an alarm to the operator interface when the differential static pressure exceeds 0.6" W.C. (adj.)

DISCHARGE AIR TEMPERATURE CONTROL:
Install a temperature sensor in the supply duct downstream of the supply fan and burner. Modulate the burner via manufacturer provided contacts to maintain setpoint.
Discharge Air Temperature Setpoint: Discharge air temperature setpoint shall 65°F (adj.)

SAFETIES:
- All safeties shall be hard wired to the supply fan starters.
- Burner high temp thermostat: High temperature thermostat shall shut-off the burner when outside air temperature is above manufacturer's recommended high temp setpoint. TCC shall coordinate with manufacturer.
- Burner low temp thermostat: Low temperature thermostat shall shut-off the buner when outside air temperature is below manufacturer's recommended low temp setpoint. TCC shall coordinate with manufacturer.
- Supply fan alarm: An alarm shall be activated upon a supply fan loss of status.
- Pilot or main flame failure; an alarm shall be activated by the make-up air unit controller to the BAS when there is a pilot or main flame failure. Upon failure, the make-up air fan and exhaust fan shall stop, and the inlet damper shall close.

4.4. ROOF MOUNTED EXHAUST FANS (EF-2):

GENERAL:
- The exhaust fan shall be controlled by the BAS.

FAN CONTROL:
- Start/Stop: The BAS system shall start the exhaust fan based on the occupancy schedule. Upon startup, the inlet air damper in the associated with the fan shall open.
- Current Status Switch: Fan status shall be detected by current switch installed according to guidelines above.

4.5. APPARATUS BAY:

- Exhaust fan EF-2 and make-up air unit MAU-2 shall operate when commanded by the BAS.
- BAS shall calculate the cumulative exhaust fan runtime over the preceding 24 hour period. If runtime is less than 5 hours, the exhaust fan and make-up air unit shall operate until the cumulative 24 hour runtime equals 5 hours.
- BAS shall monitor carbon monoxide (CO) and nitrogen dioxide (NO2) in the apparatus bay. If CO concentration in excess of 35 (adj.) parts per million (ppm) or NO2 concentration in excess of 1.0 (adj.) ppm, the exhaust fan and make-up air unit shall be commanded on.
- Hot water unit heaters (2) operate on call for heating from space temperature sensors.
- Provide contact switches on all (4) garage overhead doors to detect when doors are closed.
- While contact switches detect an open door, unit heaters and MAU-2 shall be disabled.
- If space temperature falls below 50 deg F. (adj.) override unit heater interlock and send an alarm to the BAS.

4.6. VARIABLE PRIMARY, CONDENSING HOT WATER BOILER HEATING SYSTEM

Operation:

- One pump shall be started by BAS and shall operate continuously when outdoor temperature is below 65°F (adj).
- Pumps shall be powered by powered by variable frequency drives, provided by the T.C.C. BAS shall monitor pump status and speed.

Lead/Lag (100% stand-by operation):

- If lead pump does not start, fail over to next available pump and send alarm.
- Alternate pumps in single pump operation every 400 hrs (adjustable)

Pump Capacity Control:

Vary pump speed of lead pump VFD to maintain differential pressure set point, determined by the balancing contractor.

Boiler Control:

- Packaged controller provided by the boiler manufacturer for individual boiler operation to modulate burner, provide safety control, etc. The manufacturer provided boiler controller shall communicate with the BAS via Modbus communication protocol. Integrate monitoring and alarm points provided by the boiler controller.
- Provide loop water temperature control, sequencing, lead/lag and auto rotation of boilers through BAS based on outdoor reset schedule. Initiate system operation when outdoor temperature is below 65°F (adj).
- Monitor HW loop flow via flow sensor to calculate when flow is sufficient to operate boilers in tandem based on satisfying each boiler minimum flow.

HVAC Hot Water Loop:

- Provide outdoor reset control through the BAS to reset the leaving water temperature setting proportional to the outdoor temperature.
- Provide an electronic outdoor sensor/transmitter and a LWT electronic sensor/transmitter to provide water reset control.
- Reset control shall have an adjustable ratio with initial setting of 1:1.
    - 140° F leaving water at -15° F ambient temperature
    - 110° F leaving water at 65° F ambient temperature.

Boiler Isolation Valves:

- Provide command signal for each valve through the BAS.
  Provide isolation valve end switch and water flow switch set to 11 gpm (adj.) to prove flow through boiler before operation.

4.7. COMMERCIAL KITCHEN HOOD EXHAUST AND MAKE-UP SYSTEM

Operation:

- Exhaust fan EF-1 shall operate via hood mounted momentary contact button with lighted indicator. Upon activation, BAS will command the exhaust fan to run for 15 minutes (adj.) unless overridden by the hood mounted heat sensor.
- Manufacturer provided heat sensor shall send a signal to the BAS to command EF-1 on when cooking operations are detected. The sensor shall detect when cooking has ceased and send a command to shut down the exhaust fan after a 15 min (adj.) delay.
- Direct fired make-up air unit MAU-1 shall be interlocked with EF-1.
- Upon activation of hood fire suppression system, fan shall run continuously until system is reset and an alarm shall be sent to the BAS.

5. - GRAPHICAL REPRESENTATION POINT LISTS

5.1. SUMMARY

The points required to perform the operating sequences as specified shall be accessible from the Graphical User Interface (GUI) and/or the Web browser interface (WBI). The supplier of the IDC and IBC devices shall ensure that the points required are accessible on their respective networks, by the Network Area Controller (NAC).

The graphics shall provide detailed 2-dimensional building site, 2-dimensional floor plans; and 3-dimentional equipment illustrations with fan, pump, damper, and valve animation for system operation. Each graphic shall be provided with a tabular "hot button" navigational structure enabling a "one-mouse click" access to other building systems and the return, without the use of the browser "back button".

The graphics shall provide a real-time continuous display of critical points; Outside Air Temperature, Outside Air Relative Humidity, Enthalpy, KWH, and KW visible within the HTML frame on all graphic screens.

All values shall be logged in appropriate sampling intervals.

5.2. GRAPHIC DESCRIPTION

Home Page: The graphic shall provide a geographical overview of the systems serving the building. Each building image shall be a "hot button" to access the building floor plans. The image "hot button" is indicated by a "mouse over" function highlighting the building and changing curser icon, enabling a "one-mouse click" access the building floor plans.

All points shall be displayed including but not limited to the actual value, set-value and alarms.

Floor Plans:

- The graphic shall provide an accurate dimensional layout of the building floor(s); including all rooms, room numbers, walls, elevators, doors, entrances, hallways, and stairwells. Room numbering and naming conventions shall be provided by the architect/engineer.
- All space sensors shall be placed on the Floor Plan graphic accurately depicting their location. Each sensor image shall be a "hot button" to access the associated equipment. The image "hot button" is indicated by a "mouse over" function changing curser icon, enabling a "one-mouse click" access to the equipment. The sensors shall be tagged with a real-time continuous display of their value.
- Building floor layout with large area or high density of sensors. The graphic shall provide an accurate dimensional layout of the building floor(s) divided into logical sections or areas. Each section or area shall be a "hot button" to access an expanded view. The section or area "hot button" is indicated by a "mouse over" function highlighting the section or area and changing curser icon, enabling a "one-mouse click" access to the expanded view. Expanded view; all space sensors shall be placed on the graphic accurately depicting their location. Each sensor image shall be a "hot button" to access the associated equipment. The image "hot button" is indicated by a "mouse over" function changing curser icon, enabling a "one-mouse click" access to the equipment. The sensors shall be tagged with a real-time continuous display of their value.

Mechanical Systems:

- The graphic shall provide an accurate 3-dimensional representation of the systems being controlled; including all sensors, heat exchangers, heating and cooling coils, dampers, CW/HW piping and pumps, humidifiers, flow directions, safety devices, actuators, and limit devices with fan, pump, damper, and valve animation for real-time system operation.
- All data point components shall be placed on the system graphic accurately depicting their location. Each component image shall be a "hot button" to access their respective schedule, set-points, and trend logs. The image "hot button" is indicated by a "mouse over" function changing curser icon, enabling a "one-mouse click" access to the parameters. All analog and digital components shall be tagged with a real-time continuous display of their value.
- The terminal unit graphic shall also include a reduced image of the associated AHU with animated fan status and tagged with a real-time continuous display of discharge air temperature and system static pressure.

5.3. GRAPHIC POINT TABLE

REFER TO SECTION 23 90 01

END SECTION 23 90 00

System	Exhaust Fan EF-1, EF-2					
Point	Type	Field Device	Modify Value by Admin	Alarm	Log	Comment
Fan Start/Stop	Digital Output	Control Relay				
Fan Status	Digital Input	Current		Fail	X	
Isolation Damper Command	Digital Output	2-Pos. Actuator				EF-2 Only

System	Energy Recovery Ventilator ERV-1					
Point	Type	Field Device	Modify Value by Admin	Alarm	Log	Comment
Supply Fan Start/Stop	Digital Output	Control Relay				
Supply Fan Status	Digital Input	Current		Fail	X	
Supply Isolation Damper Command	Digital Output	2-Pos. Actuator				
Exhaust Fan Start/Stop	Digital Output	Control Relay				
Exhaust Fan Status	Digital Input	Current		Fail	X	
Exhaust Isolation Damper Command	Digital Output	2-Pos. Actuator				
OA Leaving Temp	Analog Input	Duct Sensor			X	
Exhaust Leaving Temp	Analog Input	Duct Sensor			X	

System	Make-Up Air Unit MAU-1,2					
Point	Type	Field Device	Modify Value by Admin	Alarm	Log	Comment
Supply Fan Start/Stop	Digital Output	Control Relay				
Supply Fan Status	Digital Input	Current		Fail	X	
Supply Isolation Damper Command	Digital Output	2-Pos. Actuator				
Supply Isolation Damper End Switch	Digital Input	End Switch				
Burner Enable	Digital Output	Control Relay				
Burner Modulation	Analog Output	Mod. Valve				
Filter Differential Pressure	Analog Input	Sensor Duct	High Limit / Maintenance	High Limit / Maintenance		
Pilot/Main Flame Status	Digital Input	Flame Detector				
Discharge Air Temperature	Analog Input	Duct Sensor			X	
Discharge Air Setpoint	Setpoint	Software				

DIVISION 26 - ELECTRICAL
SECTION 26 00 00 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Division 7 – Through-Penetration Firestop Systems, for sealing requirements at penetrations of fire rated surfaces.

1.2 CODES AND PERMITS

A. Perform all work in strict accordance with the requirements of the State of Wisconsin Electrical Code and State of Wisconsin Energy Code. Requirements outlined therein shall be minimum as related to this work.

B. Arrange for Code required inspections and pay for same if not covered by permit costs.

C. Arrange and pay for required meter deposits and utility extension costs.

D. Arrange and pay for required fire alarm system submittals to State of Wisconsin Department of Commerce.

1.3 WORK PRIORITY AND COORDINATION

A. Contractor, his mechanics and subcontractors shall cooperate with all others so construction may proceed without hindrances and in all cases to the best interests of the Owner. Confer with others regarding any work that may affect this work and arrange piping, ductwork, equipment, etc. in proper relation to that of others. Coordinate prior to installation the arrangement of electrical work as related to plumbing, HVAC and general construction work.

1.4 DRAWINGS

A. The drawings are schematic in nature indicating the general location of all electrical equipment and devices. While the sizes and locations have been indicated, the Contractor shall properly adjust his work to meet conditions as they actually exist on the premises. Equipment and devices shall provide adequate and acceptable clearance for entry, servicing and maintenance. Minor adjustments shall be discussed with the Engineer with the view to convenience of operation and noninterference with other work. The Engineer reserves the right to change the location of any conduit, device or piece of equipment to suit conditions, with no added cost to the Owner if the requested change does not modify the scope of work. Should the particular equipment which any contractor proposes to install require other space conditions, other utility service, or other structural support than those indicated on the drawings, the Contractor shall arrange for such changes with other affected Contractors and with the Architect. Required changes shall be noted on the submittal cover sheet. Should changes become necessary the Contractor shall make such changes at his expense.

1.5 SUBMITTALS

A. Furnish shop drawings on items as indicated in individual sections including panelboards, devices, fixtures, firestopping, fire alarm equipment, and other equipment. Submit at least 6 copies for review **which represents (2) copies for A/E, (1) copy for owner review, (2) copies for O&M manuals, (0) copies for other Prime Contractors plus (1) copy to be returned to contractor**. The contractor acknowledges its responsibility to submit complete shop drawings and other required submittals. Incomplete submittals will be returned to the contractor unreviewed. No time extensions or cost increases will be allowed for delays caused by return of incomplete submittals. Shop drawings for equipment which are noted as being reviewed by Architect or his Engineer shall not supersede Contract Documents or relieve Contractor from responsibility for deviations from the Contract Documents.

B. Furnish 3 sets of standard operating instructions and complete repair parts lists for the Owner for items of equipment and controls. Also include a summary of maintenance procedures required monthly, yearly, etc. for all equipment. Submit in binders to Engineer for approval.

1.6 REMODELING WORK

A. Wherever remodeling work or demolition of existing equipment, light fixtures, conduit, etc. is a part of plans and specifications, Contractor shall visit the site and thoroughly examine all existing conditions. Provide all required work necessary for interconnection of existing services with new system and removal of existing unused components.

B. Contractors shall notify the Architect at least 10 days prior to the bid closing date of any deviations or required changes that are noticed. No allowance for additional costs for work related to existing conditions will be permitted after bidding unless proof of hidden work, breakage or damage could not be determined by inspection or examination by the Contractor.

1.7 HOUSEKEEPING

A. This Contractor shall periodically remove debris caused by his operations. On completion he shall remove all debris from his work and leave same neat and clean, ready for use by the Owner.

1.8 PROTECTION OF MATERIALS AND EQUIPMENT

A. Materials and equipment shall be protected at all times. This Contractor shall be responsible for all damage caused directly or indirectly by his workmen. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury. At the completion of all work, the equipment shall be thoroughly cleaned and delivered to the Owner in a condition satisfactory to the Engineer.

B. Equipment shall not be used during construction unless approved in writing by the Engineer. Equipment used during construction shall be returned to the original condition, which may include such items as replacing lamps, cleaning lenses, and replacing damaged devices.

1.9 PAINTING

A. All equipment shall have manufacturer's standard baked enamel finish and shall not be job painted "unless otherwise specified". Equipment in finished rooms shall have color selected by Engineer from manufacturer's standard colors. All required touch up painting

of pre-finished surfaces by this Contractor.

1.10 ELECTRICAL IDENTIFICATION

A. Every piece of equipment, starters, disconnect, etc. shall be stenciled with identifying number and area or rooms served, neatly printed and applied on or near item as approved by Engineer. Motors and equipment nameplates and applicable UL labels shall be in place, free from dirt, grease or paint when Project is turned over to Owner.

B. Panelboard directories shall be typed and shall indicate type of load and room numbers for location(s). Panelboards shall have laminated, plastic, engraved nameplates.

C. Junction boxes above the suspended ceiling, and six inches of the conduit entering the j-boxes shall be painted to identify these systems:

Fire Alarm	Red
Life Safety Power	Blue
Emergency Equipment	Green
Critical Branch Power	Yellow
Security	Orange

D. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:

1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend that indicates type of underground line.

1.11 INSTRUCTIONS

A. The Contractor shall review with the Owner's representative complete operating and maintenance procedures for equipment and systems installed under this contract. Provide 2 days of instructions during normal working hours when systems are fully operational and before final payment.

PART 2 - PRODUCTS

2.1 QUALITY REQUIREMENTS

A. Items indicated on the drawings and in the specifications are listed by manufacturer in order to describe minimum quality requirements.

B. Materials and equipment shall conform to requirements of Wisconsin Administrative Code.

C. All materials and equipment furnished shall be new and shall be the standard products of manufacturers regularly engaged in the production of Electrical and Fire Alarm materials and equipment.

END SECTION 26 00 00

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

1.2 SUMMARY

A. This Section includes the following:

1. Raceways.
2. Building wire and connectors.
3. Supporting devices for electrical components.
4. Electrical identification.
5. Electrical demolition.
6. Cutting and patching for electrical construction.
7. Touchup painting.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. IMC: Intermediate metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. RNC: Rigid nonmetallic conduit.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

C. Coordinate electrical service connections to components furnished by utility companies.

1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. EMT: ANSI C80.3, zinc-coated steel, with set-screw or compression fittings.

B. FMC: Zinc-coated steel.

C. IMC: ANSI C80.6, zinc-coated steel, with threaded fittings.

D. LFMC: Zinc-coated steel with sunlight-resistant and mineral-oil-resistant plastic jacket.

E. RNC: NEMA TC 2, Schedule 40 PVC, with NEMA TC3 fittings.

F. Raceway Fittings: Specifically designed for the raceway type with which used.

2.2 CONDUCTORS

A. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.

B. Conductors, Larger Than No. 10 AWG: Stranded copper.

C. Insulation: Thermoplastic, rated at 75 deg C minimum.

D. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated. All stranded wire shall be terminated with compression connectors.

2.3 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch-diameter slotted holes at a maximum of 2 inches o.c., in webs.

D. Slotted-Steel Channel Supports: Comply with Division 5 Section "Metal Fabrications" for slotted channel framing.

1. Channel Thickness: Selected to suit structural loading.
2. Fittings and Accessories: Products of the same manufacturer as channel supports.

E. Nonmetallic Channel and Angle Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch-diameter holes at a maximum of 8 inches, in at least one surface.

1. Fittings and Accessories: Products of the same manufacturer as channels and angles.
2. Fittings and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.

F. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

G. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

H. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

I. Expansion Anchors: Carbon-steel wedge or sleeve type.

J. Toggle Bolts: All-steel springhead type.

K. Powder-Driven Threaded Studs: Heat-treated steel.

2.4 ELECTRICAL IDENTIFICATION

A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.

1. Type: Pretensioned, wraparound plastic sleeves. Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the item it identifies.
2. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
3. Color: Black letters on orange background.
4. Legend: Indicates voltage.

C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick.

D. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:

1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend that indicates type of underground line.

E. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

F. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.

G. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.

H. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.

I. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch, galvanized-steel backing, with colors, legend, and size appropriate to the application. 1/4-inch grommets in corners for mounting.

J. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.5 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.

B. Meter Sockets: Comply with requirements of electrical power utility company.

2.6 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 RACEWAY APPLICATION

A. Use the following raceways for outdoor installations:

1. Exposed: IMC.
2. Concealed: IMC.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment: LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.

B. Use the following raceways for indoor installations:

1. Exposed: EMT.
2. Concealed: EMT.
3. Connection to Vibrating Equipment: FMC; except in wet or damp locations, use LFMC.
4. Damp or Wet Locations: IMC.
5. Boxes and Enclosures: NEMA 250, Type 1, unless otherwise indicated.

3.3 RACEWAY AND CABLE INSTALLATION

A. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.

B. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

C. Use temporary raceway caps to prevent foreign matter from entering.

D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

E. Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.

F. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Install conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.

5. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for exposed parallel raceways.

G. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.

H. Install telephone and signal system raceways, 2-inch trade size and smaller, in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.

I. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of 72-inch flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.

J. Set floor boxes level and trim after installation to fit flush to finished floor surface.

3.4 WIRING METHODS FOR POWER, LIGHTING, AND CONTROL CIRCUITS

A. Feeders: Type THHN/THWN insulated conductors in raceway.

B. Underground Feeders and Branch Circuits: Type THWN or single-wire, Type UF insulated conductors in raceway.

C. Branch Circuits: Type THHN/THWN insulated conductors in raceway.

D. Branch Circuits: Type THW or THHN/THWN insulated conductors in raceway where exposed. Metal-clad cable where concealed in dry locations of ceilings and gypsum board partitions.

E. Remote-Control Signaling and Power-Limited Circuits: Type THHN/THWN insulated conductors in raceway for Classes 1, 2, and 3, unless otherwise indicated.

3.5 WIRING INSTALLATION

A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

B. Install wiring at outlets with at least 12 inches of slack conductor at each outlet.

C. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals, according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.6 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.7 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Install 1/4-inch-diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Simultaneously install vertical conductor supports with conductors.

J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws or screw-type nails.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.

4. Existing Concrete: Expansion bolts.
5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
6. Steel: Welded threaded studs or spring-tension clamps on steel.
7. Field Welding: Comply with AWS D1.1.
8. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
9. Light Steel: Sheet-metal screws.
10. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.8 IDENTIFICATION MATERIALS AND DEVICES

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Identify raceways and cables with color banding as follows:

1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
3. Colors: As follows:

    a. Fire Alarm System: Red.
    b. Security System: Blue and yellow.
    c. Telecommunication System: Green and yellow.

E. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

F. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker.

G. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Black.
2. Phase B: Red.
3. Phase C: Blue.

H. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved

plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

I. Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

3.9 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.10 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Firestopping."

3.11 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove demolished material from Project site.

E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.12 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.13 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:

1. Raceways.
2. Building wire and connectors.
3. Supporting devices for electrical components.
4. Electrical identification.
5. Electricity-metering components.
6. Concrete bases.

7. Electrical demolition.
8. Cutting and patching for electrical construction.
9. Touchup painting.

3.14 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.15 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 05 00

SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

B. Related Sections include the following:

1. Division 26 Section "Control-Voltage Electrical Cables" for transmission media used for control and signal circuits.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

C. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 CONDUCTORS AND CABLES

A. Manufacturers:

1. Alcan Aluminum Corporation; Alcan Cable Div.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material: Copper solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger and for all motor and equipment connections regardless of size.

D. Conductor Insulation Types: Type THWN, XHHW, UF, USE and SO complying with NEMA WC 70.

E. Multiconductor Cable: Metal-clad cable, Type MC, Type NM and Type USE with ground wire.

2.3 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.
6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. Insulation displacement and spring type connectors shall be limited to composite factory products (ex. light fixtures) where maximum current shall be 5 amps or less or where indicated on plans.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance: Type THWN, single conductors in raceway.

B. Exposed Feeders: Type THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THWN, single conductors in raceway

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspaces: Type THWN, single conductors in raceway.

E. Exposed Branch Circuits, including in Crawlspaces: Type THWN, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THWN, single conductors in raceway Metal-clad cable, Type MC.

G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THWN, single conductors in raceway.

H. Underground Feeders and Branch Circuits: Type UF multiconductor cable.

I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.

J. Fire Alarm Circuits: Type THWN, in raceway Power-limited, fire-protective, signaling circuit cable as recommended by equipment manufacturer.

K. Class 1 Control Circuits: Type THHN-THWN, in raceway.

L. Class 2 Control Circuits: Type THHN-THWN, in raceway, Power-limited cable, concealed in building finishes.

3.2 INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Common Work Results for Electrical."

F. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."

G. Identify and color-code conductors and cables according to Division 26 Section "Common Work Results for Electrical."

H. Derate conductors above roof per NEC Table 310.15(B)(2)(c).

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Data: For the following:

1. Ground rods.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

D. Field Test Reports: Submit written test reports to include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with UL 467.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grounding Conductors, Cables, Connectors, and Rods:

a. Apache Grounding/Erico Inc.
b. Boggs, Inc.
c. Chance/Hubbell.
d. Copperweld Corp.
e. Dossert Corp.
f. Erico Inc.; Electrical Products Group.
g. Framatome Connectors/Burndy Electrical.
h. Galvan Industries, Inc.
i. Harger Lightning Protection, Inc.
j. Hastings Fiber Glass Products, Inc.
k. Heary Brothers Lightning Protection Co.
l. Ideal Industries, Inc.
m. ILSCO.
n. Kearney/Cooper Power Systems.
o. Korns: C. C. Korns Co.; Division of Robroy Industries.
p. Lightning Master Corp.
q. Lyncole XIT Grounding.
r. O-Z/Gedney Co.; a business of the EGS Electrical Group.
s. Raco, Inc.; Division of Hubbell.
t. Robbins Lightning, Inc.
u. Salisbury: W. H. Salisbury & Co.
v. Superior Grounding Systems, Inc.
w. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section "Low Voltage Electrical Power Conductors and Cables."

B. Material: Aluminum, copper-clad aluminum, and copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

G. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

H. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.

2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

I. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad.

B. Ground Rods: Sectional type; copper-clad.

1. Size: 3/4 by 120 inches in diameter.

C. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.

D. Test Wells: Provide handholes as specified in Division 33 Section "Underground Ducts and Utility Structures."

PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.

D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

E. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

F. Underground Grounding Conductors: Use [tinned-] copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.

D. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

G. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

H. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

F. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

G. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

3.4 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A [and UL 486B].

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

    a. Equipment Rated 500 kVA and Less: 10 ohms.
    b. Equipment Rated 500 to 1000 kVA: 5 ohms.
    c. Equipment Rated More Than 1000 kVA: 3 ohms.
    d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
    e. Manhole Grounds: 10 ohms.

4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.6 GRADING AND PLANTING

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 32 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 26 05 26

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 7 Section "Through-Penetration Firestop Systems" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
2. Division 26 Section "Common Work Results for Electrical" for supports, anchors, and identification products.
3. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. LFNC: Liquidtight flexible nonmetallic conduit.

G. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets.

C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Electri-Flex Co.
5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
6. LTV Steel Tubular Products Company.
7. Manhattan/CDT/Cole-Flex.
8. O-Z Gedney; Unit of General Signal.
9. Wheatland Tube Co.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.

E. Plastic-Coated IMC and Fittings: NEMA RN 1.

F. EMT and Fittings: ANSI C80.3.

1. Fittings: Set-screw or compression type.
2. Fittings: All steel, set screw, water tight, concrete tight. Insulated throat connectors. No push-on or indenter types permitted. Conduit Bodies: All steel threaded conduit bodies.

G. FMC: Aluminum.

H. LFMC: Flexible steel conduit with PVC jacket.

I. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers:

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
5. Certainteed Corp.; Pipe & Plastics Group.
6. Condux International.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; Division of Hubbell, Inc.
12. Spiralduct, Inc./AFC Cable Systems, Inc.
13. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

E. LFNC: UL 1660.

2.4 METAL WIREWAYS

A. Manufacturers:

1. Hoffman.
2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1 or 3R as required by area installed.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Hinged type or as indicated.

F. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.

1. Manufacturers:

a. Airey-Thompson Sentinel Lighting; Wiremold Company (The).
b. Thomas & Betts Corporation.
c. Walker Systems, Inc.; Wiremold Company (The).
d. Wiremold Company (The); Electrical Sales Division.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC compound with matte texture and [manufacturer's standard] <Insert optional color> color.

1. Manufacturers:

a. Butler Manufacturing Co.; Walker Division.
b. Enduro Composite Systems.
c. Hubbell, Inc.; Wiring Device Division.
d. Lamson & Sessions; Carlon Electrical Products.
e. Panduit Corp.
f. Walker Systems, Inc.; Wiremold Company (The).
g. Wiremold Company (The); Electrical Sales Division.

C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Emerson/General Signal; Appleton Electric Company.
3. Erickson Electrical Equipment Co.
4. Hoffman.
5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal.
7. RACO; Division of Hubbell, Inc.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet-PLM Division.
10. Spring City Electrical Manufacturing Co.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
14. Strongwell Corp.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Floor Boxes: Cast metal, fully adjustable, rectangular.

F. Floor Boxes: Nonmetallic, nonadjustable, round.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

I. Handholes: Pre-cast polymer concrete product. Minimum 8" x 18", w/o bottom. Test load of 7500 lbs for Tier 5 applications. Test of 22,500 lbs for Tier 15 appications. Quazite or equal. ANSI/SCTE 77 2002

J. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

K. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.7 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

B. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard grey paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Rigid steel or IMC.
2. Concealed: Rigid steel or IMC.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type as required by area installed.

B. Indoors:

1. Exposed: EMT

2. Concealed: EMT
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
4. Damp or Wet Locations: Rigid steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:

   a. Damp or Wet Locations: NEMA 250, Type 4, **stainless steel**.

C. Minimum Raceway Size: 1/2-inch trade size (DN 16).

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits embedded in or in contact with concrete.

3.2 INSTALLATION

A. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 26 Section "Common Work Results for Electrical."

D. Install temporary closures to prevent foreign matter from entering raceways.

E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.

3. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
4. Change from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above the floor.

I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

J. Join raceways with fittings designed and approved for that purpose and make joints tight.

1. Use insulating bushings to protect conductors.

K. Tighten set screws of threadless fittings with suitable tools.

L. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

N. Telephone and Signal System Raceways, 2-Inch Trade Size (DN 53) and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

O. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

Q. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise

transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

R. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

S. Set floor boxes level and flush with finished floor surface.

T. Set floor boxes level. Trim after installation to fit flush with finished floor surface.

U. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 26 05 33

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Outdoor photoelectric switches.
3. Switch-box occupancy sensors.
4. Indoor occupancy sensors.

B. Related Sections include the following:

1. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Lighting plan showing location, orientation, and coverage area of each sensor.
2. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.3 TIME SWITCHES

A. Manufacturers:

1. Area Lighting Research, Inc.
2. Fisher Pierce.
3. Grasslin Controls Corporation.
4. Intermatic, Inc.
5. Leviton Mfg. Company Inc.
6. Lightolier Controls; a Genlyte Company.
7. Lithonia Lighting.
8. Paragon Electric Co.
9. Square D.
10. TORK.
11. Touchplate Technologies, Inc.
12. Watt Stopper (The).

B. Digital Time Switches: Electronic, solid-state programmable units with alphanumeric display complying with UL 917.

1. Contact Configuration: As indicated.
2. Contact Rating: 30-A inductive or resistive, 240-V ac.
3. Circuitry: Allow connection of a photoelectric relay as substitute for on and off function of a program[on selected channels].
4. Astronomical Time: Selected channels.
5. Battery Backup: For schedules and time clock.

2.4 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers:

1. Area Lighting Research, Inc.

2. Fisher Pierce.
3. Grasslin Controls Corporation.
4. Intermatic, Inc.
5. Lithonia Lighting.
6. Novitas, Inc.
7. Paragon Electric Co.
8. Square D.
9. TORK.
10. Touchplate Technologies, Inc.
11. Watt Stopper (The).

B. Description: Solid state, with dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, microprocessor input, and complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.
4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.

2.5 SWITCH-BOX OCCUPANCY SENSORS

A. Manufacturers:

1. Bryant Electric; a Hubbell Company.
2. Hubbell Lighting Inc.
3. Leviton Mfg. Company Inc.
4. Lightolier Controls; a Genlyte Company.
5. Lithonia Lighting.
6. MYTECH Corporation.
7. Novitas, Inc.
8. RAB Electric Manufacturing, Inc.
9. Sensor Switch, Inc.
10. TORK.
11. Unenco Electronics; a Hubbell Company.
12. Watt Stopper (The).

B. Description: PIR type with integral power-switching contacts rated for 800 W at 120-V ac, suitable for incandescent light fixtures, flourescent light fixtures with magnetic or electronic ballasts, or 1/6-hp motors; and rated for 1000 W at 277-V ac, suitable for incandescent light fixtures, flourescent light fixtures with magnetic or electronic ballasts, or 1/3-hp motors, minimum.

1. Include ground wire.
2. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (215 to 2150 lx); keeps lighting off when selected lighting level is present.

2.6 INDOOR OCCUPANCY SENSORS

A. Manufacturers:

1. Hubbell Lighting Inc.
2. Leviton Mfg. Company Inc.
3. Lithonia Lighting.
4. MYTECH Corporation.
5. Novitas, Inc.
6. RAB Electric Manufacturing, Inc.
7. Sensor Switch, Inc.
8. TORK.
9. Unenco Electronics; a Hubbell Company.
10. Watt Stopper (The).

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:

   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted though a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (215 to 2150 lx); keeps lighting off when selected lighting level is present.

2.7 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG, complying with Division 26 Section "[Common Work Results for Electrical] [Low-Voltage Electrical Power Conductors and Cable]."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 18 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cable."

C. Class 1 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 14 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cable."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cable." Minimum conduit size shall be 1/2 inch (13 mm).

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Common Work Results for Electrical."

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify actuation of each sensor and adjust time delays.

B. Remove and replace lighting control devices where test results indicate that they do 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.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION 26 09 23

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the replacement of existing single phase panelboards with new three phase panelboards,overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:

1. Lighting and appliance branch-circuit panelboards.
2. Distribution panelboards.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

F. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.
c. Short-circuit current rating of panelboards and overcurrent protective devices.
d. UL listing for series rating of installed devices.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section " Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event."
3. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event."
4. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
5. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

E. Field Test Reports: Submit written test reports and include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

G. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.7 EXTRA MATERIALS

A. Keys: Six spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:

a. Eaton Corp.; Cutler-Hammer Products.
b. General Electric Co.; Electrical Distribution & Control Div.
c. Siemens Energy & Automation, Inc.
d. Square D Co.

2.2 FABRICATION AND FEATURES

A. Enclosures: Flush and surface mounted cabinets as indicated on drawings. NEMA PB 1, Type 1, to meet environmental conditions at installed location.

1. Wet or Damp Indoor Locations: NEMA 250, Type 4.

B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

C. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.

F. Bus: Hard-drawn copper, 98 percent conductivity or Tin-plated aluminum.

G. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.

H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

I. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

K. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

L. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

M. Split Bus: Vertical buses divided into individual vertical sections.

N. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

O. Gutter Barrier: Arrange to isolate individual panel sections.

P. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

Q. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISTRIBUTION PANELBOARDS

A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.

B. Main Overcurrent Protective Devices: Circuit breaker.

C. Branch overcurrent protective devices shall be one of the following:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.

2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
3. Fused switches.

2.6 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

2.7 CONTROLLERS

A. Motor Controllers: NEMA ICS 2, Class A combination controller equipped for panelboard mounting and including the following accessories:

1. Individual control-power transformers.
2. Fuses for control-power transformers.
3. Bimetallic-element overload relay.
4. Melting-alloy overload relay.
5. Indicating lights.
6. Seal-in contact.

7. (2) sets convertible auxiliary contacts.
8. Push buttons.
9. Selector switches.

B. Contactors: NEMA ICS 2, Class A combination controller equipped for panelboard mounting and including the following accessories:

1. Individual control-power transformers.
2. Fuses for control-power transformers.
3. Indicating lights.
4. Seal-in contact.
5. (2) sets convertible auxiliary contacts.
6. Push buttons.
7. Selector switches.

C. Controller Disconnect Switches: Fused switch or Non-Fused integrally mounted and interlocked with controller.

1. Auxiliary Contacts: Integral with disconnect switches to de-energize external control-power source.

D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held general-purpose controller.

1. Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. Control-Power Source: 120-V branch circuit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Division 16 Section "Seismic Controls for Electrical Work."

C. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated.

D. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

E. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

F. Install filler plates in unused spaces.

H. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

I. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Common Work Results for Electrical."

B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Common Work Results for Electrical."

B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

C. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

D. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

E. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:

F. Measure as directed during period of normal system loading. Coordinate and schedule with owner.

G. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.

H. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.

I. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

J. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.

K. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

L. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Single and duplex receptacles, ground-fault circuit interrupters, integral surge suppression units, and isolated-ground receptacles.
2. Single- and double-pole snap switches and dimmer switches.
3. Device wall plates.
4. Pin and sleeve connectors and receptacles.
5. Floor service outlets, poke-through assemblies, and multioutlet assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. PVC: Polyvinyl chloride.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wiring Devices:

a. Bryant Electric, Inc./Hubbell Subsidiary.
b. Eagle Electric Manufacturing Co., Inc.
c. Hubbell Incorporated; Wiring Device-Kellems.
d. Leviton Mfg. Company Inc.
e. Pass & Seymour/Legrand; Wiring Devices Div.

2. Wiring Devices for Hazardous (Classified) Locations:

a. Crouse-Hinds/Cooper Industries, Inc.; Arrow Hart Wiring Devices.
b. EGS/Appleton Electric Company.
c. Killark Electric Manufacturing Co./Hubbell Incorporated.

3. Multioutlet Assemblies:

a. Hubbell Incorporated; Wiring Device-Kellems.
b. Wiremold Company (The).

4. Poke-Through, Floor Service Outlets and Telephone/Power Poles:

a. Hubbell Incorporated; Wiring Device-Kellems.
b. Pass & Seymour/Legrand; Wiring Devices Div.
c. Square D/Groupe Schneider NA.
d. Thomas & Betts Corporation.
e. Wiremold Company (The).

2.2 RECEPTACLES

A. Straight-Blade-Type Receptacles: Configuration 5-20R duplex receptacle. Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.

B. Straight-Blade and Locking Receptacles: Heavy-Duty grade.

C. GFCI Receptacles: Straight blade, non-feed through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.

D. Isolated-Ground Receptacles: Straight blade, Heavy-Duty grade, duplex receptacle, with equipment grounding contacts connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap.

1. Devices: Listed and labeled as isolated-ground receptacles.
2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.

E. TVSS Receptacles: Straight blade, NEMA WD 6, Configuration 5-20R, with integral TVSS in line to ground, line to neutral, and neutral to ground.

1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp level rating of 500 volts and minimum single transient pulse energy dissipation of 140 J line to neutral, and 70 J line to ground and neutral to ground.
2. Active TVSS Indication: Visual only with light visible in face of device to indicate device is "active" or "no longer in service."
3. Receptacle Type: Heavy-Duty grade, with isolated-ground terminal.
4. Identification: Distinctive marking on face of device to denote TVSS-type unit.

F. Industrial Heavy-Duty Pin and Sleeve Devices: Comply with IEC 309-1.

2.3 SWITCHES

A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.

B. Proprietary connectors for wiring of switches are not acceptable.

C. Snap Switches: Heavy-Duty grade, quiet type.

1. Lockable Switch: Snap switch with Arrow Hart Lockable Switch Guard #7949 or equal.

D. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.

1. Switch: 20 A, 120/277-V ac.
2. Receptacle: NEMA WD 6, Configuration 5-15R.

E. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.

1. Control: Continuously adjustable slider; with single-pole or three-way switching to suit connections.
2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable rotary knob, toggle switch, or slider; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; and 5-inch (130-mm) wire connecting leads.
3. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination

capable of consistent dimming with low end not greater than 20 percent of full brightness.

F. Timer Switches: Electronic, Single- Pole/3-Way, Adjustable, up to 24 Hour, 120-277V, LED display

1. Minimum Contact Ratings:
   a. Resistive: 20 Amp, 120-277 VAC, 1800 watts
   b. Tungsten: 15 Amp, 120 VAC
   c. Ballast: 16 Amp, 120-277 VAC
   d. Motor: 1 HP, 120 VAC
   e. DC Loads: 2 Amps – 12 VDC, 4 Amps – 28 VDC

2. Replaceable Lithium Battery to provide minimum 2- year life for memory of user selections. Low battery indicator on display.

3. Field selectable audible and/or visual signal.

4. Basis of design: Intermatic model EI1400 series

2.4 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic or 0.035-inch-(1-mm-) thick, satin-finished stainless steel
3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
4. Material for Wet Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."

2.5 MULTIOUTLET ASSEMBLIES

A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: Metal, with manufacturer's standard finish.

C. Wire: No. 12 AWG.

D. Pre-wired products are not acceptable.

2.6 FINISHES

A. Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect on a room by room basis, unless otherwise indicated or required by NFPA 70.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

B. Install wall dimmers to achieve indicated rating after derating for ganging according to manufacturer's written instructions.

C. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.

D. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

E. Remove wall plates and protect devices and assemblies during painting.

F. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 TIMER SWITCH SETTINGS:

A. 15 Minute Timer: (Typical Shower Rooms, Heat Lamps)
   1. Set Audible "Beep" warn
   2. Set All for lock
   3. Set for 15 minutes

B. 1 Hour Timer:
   1. Set warn
      a. All for incandescent, LED and fluorescent
      b. Audible "Beep" for metal halide
   2. Set All for lock
   3. Set for 1 hour

C. 2 Hour Timer: (Lighting functions that must meet a code limit for 2 hour maximums)
   1. Set warn
      a. All for incandescent, LED and fluorescent
      b. Audible "Beep" for metal halide
   2. Set All for lock
   3. Set for 2 hour

D. 12 Hour Timer: (Mechanical Spaces)
   1. Set warn
      a. Visible "Flash" for incandescent, LED and fluorescent
      b. Audible "Beep" for metal halide
   2. Set All for lock
   3. Set for 12 hour

3.3 IDENTIFICATION

A. Comply with Division 26 Section "Common Work Results for Electrical."

   1. Receptacles: Identify panelboard and circuit number from which served. Use lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 26 27 26

SECTION 26 36 00 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Nonautomatic transfer switches.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, sections, and elevations showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Wiring Diagrams: Single-line diagram. Show connections between transfer switch, switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

C. Qualification Data: For manufacturer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, for manual operation.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Testing Qualifications: An agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain nonautomatic transfer switches through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for emergency service under UL 1008, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA ICS 1.

F. Comply with NFPA 70.

G. Comply with NFPA 99.

H. Comply with NFPA 110.

I. Comply with UL 1008 unless requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Contactor Transfer Switches:

a. Emerson; ASCO Power Technologies, LP.
b. GE Zenith Controls.
c. Russelectric, Inc.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

C. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

D. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

E. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

F. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.

1. Designated Terminals: Pressure type suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.

G. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

H. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

2.3 NONAUTOMATIC TRANSFER SWITCHES

A. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." In addition, removable manual handle provides quick-make, quick-break manual-switching action. Switch is capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.

B. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.

2.4 NONAUTOMATIC TRANSFER-SWITCH ACCESSORIES

A. Pilot Lights: Indicate source to which load is connected.

B. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternate-source sensing circuits.

1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
2. Emergency Power Supervision: Red light with nameplate engraved "Alternate Source Available."

C. Unassigned Auxiliary Contacts: One set of normally closed contacts for each switch position, rated 10 A at 240-V ac.

2.5 FINISHES

A. Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

2.6 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 APPLICATION

A. Four-Pole Switches: Where four-pole switches are indicated, install neutral switching.

3.2 INSTALLATION

A. Mount to wall using ¾" painted plywood panel and steel channel.

B. Identify components according to Division 26 Section "Common Work Results for Electrical."

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.22.3. Certify compliance with test parameters.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.

4. After energizing circuits, demonstrate operational function for each switch at least three times.

C. Coordinate tests with tests of generator and run them concurrently.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 26 36 00

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures with lamps and ballasts.
2. Lighting fixtures mounted on exterior building surfaces.
3. Emergency lighting units.
4. Exit signs.
5. Accessories, including fluorescent fixture dimmers, occupancy sensors.

B. Related Sections include the following:

1. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
2. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, and occupancy sensors.

1.3 DEFINITIONS

A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.

B. CRI: Color rendering index.

C. CU: Coefficient of utilization.

D. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:

1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.

E. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of fixture, including dimensions and verification of indicated parameters.
2. Emergency lighting unit battery and charger.

3. Fluorescent and high-intensity-discharge ballasts.
4. Air and Thermal Performance Data: For air-handling fixtures. Furnish data required in "Submittals" Article in Division 23 Section "Diffusers, Registers, and Grilles."
5. Sound Performance Data: For air-handling fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Division 23 Section "Diffusers, Registers and Grilles."
6. Lamps.

B. Shop Drawings:

1. Show details of nonstandard or custom fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
2. Detail assemblies of equipment indicating dimensions, weights, components, and location and identification of each field connection for Central Inverter Systems. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement.

C. Wiring Diagrams: Power, signal, and control wiring.

D. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which lighting-fixture suspension systems will be attached.
3. Other items in finished ceiling, including the following:

    a. Air outlets and inlets.
    b. Speakers.
    c. Sprinklers.
    d. Access panels.

4. Perimeter moldings.

E. Samples for Verification: For interior lighting fixtures designated for sample submission in the Interior Lighting Fixture Schedule.

1. Lamps: Specified units installed.
2. Ballast: 120-V models of specified ballast types.
3. Accessories: Cords and plugs.

F. Product Certificates: For each type of ballast for dimmer-controlled fixtures, signed by product manufacturer.

G. Source quality-control test reports.

H. Field quality-control test reports.

I. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Catalog data for each fixture. Include the diffuser, ballast, and lamps installed in that fixture.

J. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicted, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

E. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

F. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Emergency Lighting Unit Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 7 years from date of Substantial Completion. Full warranty shall apply for first three years, and prorated warranty for the remaining four years.

B. Special Warranty for Fluorescent Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
2. Warranty Period for Electromagnetic Ballasts: Three years from date of Substantial Completion.

C. Manufacturer's Special Warranty for T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: One year from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Battery and Charger Data: One for each emergency lighting unit.
4. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 FIXTURES AND COMPONENTS, GENERAL

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

E. Metal Parts: Free of burrs and sharp corners and edges.

F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to

prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

I. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

   a. Lens Thickness: At least 0.125 inch minimum unless different thickness is scheduled.
   b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 LIGHTING FIXTURES

A. Fixture

1. Refer to fixture schedule on drawings.
2. Voltage: 120V ac.
3. Mounting: As indicated on drawings and schedule.
4. Lamps: <Insert quantity and description if not indicated elsewhere.>
5. Ballast Types and Features: As indicated on drawings and as specified herein.
6. Submit Sample if requested by Engineer.
7. Provide fixtures as needed for mockups.

2.4 FLUORESCENT LAMP BALLASTS

A. Description: Include the following features, unless otherwise indicated:

1. Designed for type and quantity of lamps indicated at full light output except for emergency lamps powered by in-fixture battery-packs.
2. Externally fused with slow-blow type rated between 2.65 and 3.0 times the line current.

B. Premium Electronic Ballasts (PEB) for linear lamps shall have the following features, unless otherwise indicated.

1. Comply with NEMA C82.1.
2. Ballast type: Programmed start, parallel wired.
3. Sound Rating: A
4. Total harmonic distortion shall not exceed 10 percent according to NEMA C82.11
5. Ballast factor (as indicated on plans):

   a. Low Ballast Factor (LBF) 0.75-0.78
   b. Normal Ballast Factor (NBF) 0.85-0.88

c. High Ballast Factor (HBF) 1.15-1.20

6. Transient Voltage Protection: IEEE 587, Category A
7. Operating Frequency: 20 kHz or higher.
8. Lamp Current Crest Factor: Less than 1.7.
9. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.
10. Ballasts shall meet (Wisconsin) Focus on Energy guidelines (2007-2008) for commercial building rebates. http://www.focusonenergy.com
11. Manufacturers:

    a. Advance Transformer (Optanium)
    b. General Electric Lighting (Ultramax)
    c. Osram Sylvania (Quicktronic – High Efficiency)
    d. Or approved equal

C. Ballasts for compact lamps in recessed fixtures shall have the following features, unless otherwise indicated:

1. Type: Electronic
2. Power Factor: 90 percent, minimum.
3. Flicker: Less than 5 percent.
4. Lamp Current Crest Factor: Less than 1.7.
5. Electronic Ballast Operating Frequency: 20 kHz or higher.
6. Lamp end-of-life detection and shutdown circuit.
7. Transient Protection: Comply with IEEE 587 for Category A1 locations.
8. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

D. Ballasts for compact lamps in nonrecessed fixtures shall include the following features, unless otherwise indicated:

1. Power Factor: 90 percent, minimum.
2. Ballast Coil Temperature: 65 deg C, maximum.
3. Transient Protection: Comply with IEEE 587 for Category A1 locations.
4. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

E. Ballasts for dimmer-controlled fixtures shall comply with general and fixture-related requirements above for electronic ballasts and the following features:

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming system indicated.

F. Ballasts for Low-Temperature Environments:

1. Temperatures 0 deg F and Higher: Electronic or electromagnetic type rated for 0 deg F starting temperature.
2. Temperatures Minus 20 deg F and Higher: Electromagnetic type designed for use with high-output lamps.

G. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

2.5 EXIT SIGNS

A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

2.6 EMERGENCY LIGHTING UNITS

A. General: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Wire Guard: Where indicated, heavy-chrome-plated wire guard protects lamp heads or fixtures.
5. Integral Time-Delay Relay: Holds unit on for fixed interval when power is restored after an outage; time delay permits high-intensity-discharge lamps to restrike and develop adequate output.

2.7 FLUORESCENT EMERGENCY LIGHTING FIXTURES

A. Internal Type: Self-contained, modular, battery-inverter unit factory mounted within fixture body. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Night Light Connection: Operate one fluorescent lamp continuously.
3. Test Switch and Light-Emitting-Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
4. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum seven-year nominal life.
5. Charger: Fully automatic, solid-state, constant-current type.

B. Central Type: Factory installed, full light output, fluorescent emergency ballast to operate lamps indicated from a remote emergency power source.

C. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more fluorescent lamps, remote mounted from light fixture. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Night Light Connection: Operate one fluorescent lamp in a remote fixture continuously.
3. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum seven-year nominal life.
4. Charger: Fully automatic, solid-state, constant-current type.
5. Housing: NEMA 250, Class 1 enclosure.

2.8 FLUORESCENT LAMPS

A. Low-Mercury Lamps: Comply with Federal toxic characteristic leaching procedure test, and yield less than 0.2 mg of mercury per liter, when tested according to NEMA LL 1.

B. T8, medium bi-pin, low mercury, extended life lamps (ELF), rated 32 W maximum, CRI of 80 (minimum), color temperature of 4100K, minimum average rated life of 24,000 hrs based on 3-hrs per start, instant start. 3100 initial lumens (minimum). Lamps shall meet the Wisconsin Focus on Energy Rebate Program.

1. Manufacturers:

a. Philips (Alto Advantage)
b. General Electric Lighting (Ecolux Hi-Lumen Starcoat)
c. Osram Slyvania (Octron XPS)

C. Compact Fluorescent Lamps: CRI 80 (minimum), color temperature 3500, average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.

1. T4, Twin Tube: Rated 5 W, 250 initial lumens (minimum).
2. T4, Twin Tube: Rated 7 W, 400 initial lumens (minimum).
3. T4, Twin Tube: Rated 9 W, 600 initial lumens (minimum).
4. T4, Twin Tube: Rated 13 W, 825 initial lumens (minimum).
5. T4, Double-Twin Tube: Rated 13 W, 900 initial lumens (minimum).
6. T4, Double-Twin Tube: Rated 18 W, 1200 initial lumens (minimum).
7. T4, Double-Twin Tube: Rated 26 W, 1800 initial lumens (minimum).

2.9 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Common work Results for Electrical" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gage.

E. Wires For Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch-minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

H. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.10 FINISHES

A. Fixtures: Manufacturers' standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
2. Metallic Finish: Corrosion resistant.

2.11 LIGHTING CONTROL DEVICES

A. Dimming Ballast Controls: Sliding-handle type with on/off control; compatible with ballast and having light output and energy input over the full dimming range.

B. Light Level Sensor: Detect changes in ambient lighting level and provide dimming range of 20 to 100 percent in response to change.

1. Sensor Capacity: At least 40 electronic dimming ballasts.
2. Adjustable Ambient Detection Range: 10 to 100 fc minimum.

C. Occupancy Sensors: Adjustable sensitivity and off delay time range of 5 to 15 minutes.

1. Device Color:

a. Wall Mounted: Ivory.
b. Ceiling Mounted: White.

2. Occupancy detection indicator.
3. Ultrasonic Sensors: Crystal controlled with circuitry that causes no detection interference between adjacent sensors.
4. Infrared Sensors: With daylight filter and lens to afford coverage applicable to space to be controlled.
5. Combination Sensors: Ultrasonic and infrared sensors combined.

2.12 SOURCE QUALITY CONTROL

A. Provide services of a qualified, independent testing and inspecting agency to factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

B. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from fixture corners.
2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Fixture Support: As follows:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Continuous Rows: Suspend from cable.

D. Air-Handling Fixtures: Install with dampers closed and ready for adjustment.

E. Adjust aimable fixtures to provide required light intensities.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FORMS

A. Contractor shall provide documentation on lamps and ballast purchases and shall fill out the Wisconsin Focus on Energy Forms for Owner Rebates.

3.4 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Verify normal operation of each fixture after installation.

C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

E. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

1 END OF SECTION 26 51 00

SECTION 27 15 00 - COMMUNICATIONS CABLE AND EQUIPMENT

PART ONE - GENERAL

1.1 SCOPE

A. This section describes the products and execution requirements relating to furnishing and installation of Telecommunications Cabling and Termination Components and related sub-systems as part of a Structured Cabling System. Included are the following topics:

PART 1 - GENERAL

Scope
Related Work
Regulatory References
Design Intent
Work Sequence
Submittals
Quality Assurance
Delivery, Storage and Handling
Drawings

PART 2 - PRODUCTS

Indoor Type Fiber Optic Cable
Standard Information Outlet
Patch Panel
Fiber Optic Patch Panels
Equipment Rack
Flexible Nonmetallic Innerduct and Fittings
Miscellaneous Materials

PART 3 - EXECUTION

General
Innerduct
Cable Termination
Testing and Acceptance
Documentation
As-Built Construction Drawings
Warranty

1.2 RELATED WORK AND REQUIREMENTS

A. Work of Related Sections:

1. Section 01 33 00 – Submittals
2. Section 27 15 01 – Commissioning of Communications Cable and Equipment
3. Section 16 00 00 – Common Work Results for Electrical
4. Section 26 05 33 – Raceways and Boxes for Electrical
5. Section 26 05 26 – Grounding and Bonding for Electrical

1.3 REGULATORY REFERENCES

A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the Wisconsin Electrical Code and present manufacturing standards.

B. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

C. Other applicable standards are as follows:

1. ANSI/IEEE C2 - National Electrical Safety Code
2. NFPA 70- 2005 - National Electrical Code
3. Comm. Chapter 16 - Wisconsin Electrical Code
4. TIA/EIA Standards 526-14A (OFSPT-14A), 526-7 (OFSPT-7), 568B.2 (Category 6), 568B.3, 569A, 606A, and 607 (with exception)
5. IEEE/ANSI 142-1982 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
6. ICEA publication S-80-576-2002

1.4 DESIGN INTENT

A. The Station Cabling System is based on the installation of 4-Pair Unshielded Twisted Pair (UTP) DATA Category 6. Cables installed in free air shall be plenum rated. The cables shall be installed from the Standard Information Outlet (SIO) in the work area to the Telecommunications Rack (TR) serving that area and terminated as specified in this document.

B. Station cables shall be installed in conduit. Outlets shall be mounted in back boxes. Standard Information Outlet locations are to be identified on Project Drawings.

C. Fiber Optic Cables (linking Telecommunications Racks) shall be installed in plenum rated innerduct.

D. At the Main Equipment Rack Station, Fiber Optic and Coaxial cable terminations shall be mounted on a freestanding equipment rack.

E. All cables and related termination, support and grounding hardware, bonding, shall be furnished, installed, wired, tested, labeled, and documented by the Contractor, as detailed in the following sections.

F. The Contractor shall provide all labor and materials necessary to construct the system as described herein. This includes - but is not limited to - furnishing and installing cable, cable supports, innerduct, racking and termination components, termination, testing, labeling and documentation.

1.5 COORDINATION

A. During the project and warranty period, coordinate telecommunications system(s) installation and testing with the General Contractor, Section 27 15 01 Communications Commissioning Contractor, Engineer, the respective user group(s), and the City of Madison Information Services department.

B. All correspondence between the Section 27 15 00 contractor and the commissioning contractor shall be copied to the General Contractor, Owner and Engineer.

1.6 SUBMITTALS

A. **Submit documentation of the contractor's BICSI certified project manager along with bid. Not including clear documentation of BICSI certification will be grounds for rejection of bid**.

B. Under the provisions of Section 01 33 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Six (6) sets of Manufacturer's Data covering all products proposed indicating construction, materials, ratings and all other parameters identified in Part 2 (Products) below.
2. Manufacturer's installation instructions.
3. One (1) two-foot section of each cable type to be utilized for final approval by the Engineer. This two-foot section shall have the manufacturer's cable markings visible.

C. Submittals should be grouped to include complete documentation of related systems, products and accessories in a single submittal. Where applicable, dimensions should be marked in units to match those specified.

D. Submittals shall be original catalog sheets or photocopies.

E. Work shall not proceed without the Engineer's approval of the submitted items.

F. If the Contractor wishes to substitute another manufacturer and/or catalog number, the following information shall be submitted to the Engineer for review:

1. A complete description of the material which the contractor proposes to substitute (shop drawings, illustrations, catalog data, performance characteristics, etc.) and the reason for the substitution identifying any benefit to the Owner. Include a letter stating that the proposed products are equal or better than the specified materials.

G. The Contractor shall receive approval from the Engineer on all substitutions of material. No substituted materials shall be installed except by written approval from the Engineer.

1.7 QUALITY ASSURANCE

A. The manufacturer shall be a company specializing in communication cable and/or accessories with a minimum of five years documented experience in installing cable and/or accessories similar to those specified below.

B. The contractor shall have been in this line of business for a minimum of five (5) years and completed four (4) jobs of the magnitude specified in this section.

C. The installing contractor shall have a BICSI certified technician be the project manager. The Certified Installer shall have been trained by a company(s) that offer a minimum fifteen (15) year system warranty.

1.8 DELIVERY, STORAGE AND HANDLING

A. Cable shall be stored according to manufacturer's recommendations as minimum. In addition, cable must be stored in a location protected from vandalism and weather. If cable is stored outside, it must be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 4 degrees C., the cable shall be moved to a heated (10 degrees C. minimum) location.

B. If the contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the Owner. If necessary, cable shall be stored off site at the contractor's expense.

1.9 DRAWINGS

A. It shall be understood that the electrical and telecommunication details and drawings provided with the specification package are diagrammatic.

B. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.

C. Prior to submitting the bid, the Contractor shall call the attention of the Engineer to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted, within ten (10) days prior to the Bid Due Date.

1.10 AS-BUILT CONSTRUCTION DRAWINGS

A. Drawings included with the specifications set shall be modified by the contractor to denote as-built information.

B. The drawings are to include equipment rack, cable pathways and SIO locations. SIO locations shall be identified by their sequential number as defined elsewhere in this document. Numbering and drawing conventions used shall be consistent throughout all documentation provided.

C. The Engineer will furnish floor plans in electronic (".dwg", AutoCAD rel. 2004) formats on which as-built construction information can be added. These documents will be modified by the contractor to denote as-built information as defined above and returned to the Engineer for review. This information shall be supplied to the Engineer no later than four (4) weeks prior to the scheduled occupancy of the project.

D. The Contractors shall annotate the base drawings and return to the Engineer in hard copy (same plot size as originals) and electronic (AutoCAD rel. 2004) form.

E. Each drawing submitted by the Contractor as part of the Project Documentation shall be identified as an "As-built" drawing and include the following (1) The Contractor name and/or logo (2) The date of the drawing.

F. All fonts, color, layer, Model Space/Paper Space conventions established in the base drawings shall be retained by the Contractor in preparation of the As-built drawings.

G. SIO labels and station cable pathways shall be shown on separate layers in AutoCAD.

H. All documentation, including hard copy and electronic forms shall become the property of the City of Madison.

1.11 WARRANTY

A. This Contractor shall guarantee all materials, equipment, etc., two (2) years from date of substantial completion of this work. In the case of patch panels, station cabling and SIO's the contractor shall furnish complete Category 6 system warranty consisting of no less than fifteen (15) years. This guarantee shall include all labor, material and travel time. In the case of multi-mode or single mode fiber cabling the contractor shall furnish a complete system warranty consisting of no less than fifteen (15) years.

B. In the event of a warranty claim, the owner will contact the section 27 15 01 contractor first to review the item of concern. If corrective action is required, the section 27 15 00 contractor will receive direction from the section 27 15 01 contractor, and then perform the necessary work to correct the situation. The section 27 15 00 contractor will then test the work to show conformance with this section. Test results will be submitted to the section 27 15 01 contractor for review. All aspects of section "**Coordination with Section 27 15 01 Telecommunications Commissioning Contractor**" apply to a warranty claim.

1.12 FINAL PAYMENT

A. Final payment will not be made until the Section 27 15 01 contractor's certification of commissioning letter is submitted and accepted by the Owner.

PART TWO - PRODUCTS

2.1 BACKBONE FIBER OPTIC CABLE

A. General

1. Cables shall incorporate Optical fibers meeting the specifications detailed in the sub-section(s) below. Backbone Fiber Optic Cable sizing (fiber count) shall be per Project Drawings. Fiber cables installed in a Plenum area shall be installed in Plenum rated innerduct and have a Plenum rated fiber optic cable jacket.

2.2 INDOOR TYPE FIBER OPTIC CABLE

A. This cable shall be suitable for installation in building riser systems, in conduit, in cable tray or in innerduct.

B. Cable materials shall be all dielectric (no conductive material).

C. Cable shall carry an OFNR rating (Optical Fiber Non-Conductive Riser)

D. Outer Sheath: PVC

1. The outer sheath shall be marked with the manufacture's name, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet.

E. Temperature Range:

1. Storage: -40° to +70°C (no irreversible change in attenuation)
2. Operating -40° to +70°C

F. Humidity Range: 0 to 100%

G. Max. Tensile Load (Riser and Tie)

1. During Installation: 1332 Newton (300 lb. force) (no irreversible change in attenuation)
2. Long Term: 600 N (135-lb. force)

H. Bending Radius:

1. During Installation: 20 times cable diameter
2. No Load: 10 times cable diameter

2.3 INDOOR/OUTDOOR FIBER OPTIC CABLE

A. "Hybrid" cables suitable for installation in multiple environments (e.g. underground duct and building risers) may be used at Contractor's option.

1. Such cables shall meet all specifications noted above for cables designated for each environment through which the cable shall pass.

B. Backbone Fiber Optic Cable

1. This cable shall be suitable for installation free-air, in building Risers, in Conduit, in Cable Tray and/or in Innerduct.
2. Cable Materials shall be all dielectric (no conductive materials).
3. Cabling shall carry an OFNR rating (Optical Fiber Non-Conductive Riser) and shall be listed as being suitable for use in a vertical run in a shaft or from floor to floor and shall be listed as having fire-resistant characteristics capable of preventing the carrying of fire from floor to floor. An acceptable method of defining fire-resistant characteristics shall be that the cable passes the requirements of the Standard Test for Flame Propagation Height of Electrical and Optical-Fiber Cable Installed Vertically in Shafts (ANSI/UL 1666-2000).

C. Outer Sheath: PVC

1. The Outer Sheath shall be marked with the manufacturer's name, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet.

D. Temperature Range:

1. Storage: -40o to +70 °C (no irreversible change in attenuation)
2. Operating: -20o to +70 °C (OFNR)

E. Humidity Range: 0 to 100%

F. Max. Tensile Load (Backbone Intra-building)

1. ≥ 12-fibers

a. During Installation: 1332 Newton's (300 lb. force) (no irreversible change in attenuation)
b. Long Term: 600 N (135 lb. force)

2. <12-fibers

a. During Installation: 1000 Newton's (225 lb. force) (no irreversible change in attenuation)

b. Long Term: 300 N (67 lb. force)

G. Bending Radius:

1. During Installation: 20 times cable diameter
2. No Load: 10 times cable diameter.

H. Optical Fiber Specifications - Backbone Cable

1. General

a. The fiber count in each cross-section will vary. For quantities and other design information, refer to the Project Drawings.
b. All optical fibers shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification. Factory optical fiber splices are not allowed.
c. All fibers shall have been subjected to a minimum tensile proof test by the fiber manufacturer equivalent to 100-kpsi.
d. All fibers in each cable shall be guaranteed to meet the stated specifications.

I. Multi-mode Optical Fibers (62.5/125)

1. Multi-mode Optical Fibers in each cable shall meet the following specifications:

a. Fiber Type: Multi-mode; doped silica core surrounded by a concentric glass cladding.
b. Index Profile: Graded Index
c. Transmission Windows: 850-nm and 1300-nm
d. Core Diameter (nom): 62.5-μm (microns) ± 3
e. Cladding Diameter: 125-μm ± 2
f. Core-clad Concentricity: ≤ 3-μm
g. Cladding Non-circularity: ≤ 2.0%
h. Fiber Coating Diameter: 250-μm ± 15 (primary coating)
i. All coatings shall be mechanically strippable without damaging the optical fiber.
j. Attenuation (max. @ 23±5 °C; Backbone)

@ 850-nm 3.5-dB/km
@ 1300-nm 1.0-dB/km

k. Changes to multi-mode fiber performance at extreme operational temperatures (-40 to +70 C) shall not exceed 0.2 dB/km at 1300 nm (per FOTP-3 procedures).
l. Bandwidth (min.)

@ 850-nm 200-MHz*km
@ 1300-nm 500-MHz*km

m. No multi-mode optical fiber shall show a point discontinuity greater than 0.2 dB at the specified wavelengths. Such a discontinuity or any discontinuity showing a reflection at that point shall be cause for rejection of that fiber by the Owner.

J. Multi-mode Optical Fibers (50.0/125) Laser Optimized

1. Multi-mode Optical Fibers in each cable shall meet the following specifications:

a.	Fiber Type	Multi-mode; doped silica core surrounded by a concentric glass cladding.
b.	Index Profile	Graded Index
c.	Transmission Windows	850-nm and 1300-nm
d.	Core Diameter (nom)	50.0-µm (microns) ± 3
e.	Cladding Diameter	125-µm ± 2
f.	Core-clad Concentricity	≤ 3-µm
g.	Cladding Non-circularity	≤ 2.0%
h.	Fiber Coating Diameter	250-µm ± 15 (primary coating)

i. All coatings shall be mechanically strippable without damaging the optical fiber.

j. Attenuation (max. @ 23±5 °C; Backbone)

@ 850-nm	3.0-dB/km
@ 1300-nm	1.0-dB/km

k. Changes to multi-mode fiber performance at extreme operational temperatures (-40 to +70 C) shall not exceed 0.2 dB/km at 1300 nm (per FOTP-3 procedures).

l. Bandwidth (min.)

@ 850-nm	2000-MHz*km
@ 1300-nm	500-MHz*km

m. No multi-mode optical fiber shall show a point discontinuity greater than 0.2 dB at the specified wavelengths. Such a discontinuity or any discontinuity showing a reflection at that point shall be cause for rejection of that fiber by the Owner.

K. Single Mode Optical Fibers

1.	Fiber Type	Single mode; doped silica core surrounded by a concentric glass cladding.
2.	Core Diameter:	8-9 µm. All fibers shall be of the same nominal core diameter and profile.
3.	Cladding Diameter:	125±1.0µm
4.	Cladding Non-circularity:	≤ 1%
5.	Core to Cladding Offset	≤ 0.8 µm
6.	Fiber Coating Diameter:	245±15µm (primary coating). 900-µm (nominal) secondary coating (tight buffer)

7. All coatings shall be mechanically strippable without damaging the optical fiber.
8. Cutoff Wavelength (cabled fiber; λccf) < 1260-nm.
9. Mode Field Diameter: 8.3 - 9.8 nm at 1300-nm; 10.5±1.0 µm at 1550-nm.
10. Zero Dispersion Wavelength (λ0): 1301.5 nm < λ0 < 1321.5 nm
11. Zero Dispersion Slope (S0): < 0.092 ps/nm2*km
12. Fiber Attenuation (max. @ 23±5 °C; Backbone):\

	Intra-Building	Inter-Building
@ 1300-nm	1.0 dB/km	0.5 dB/km
@ 1550-nm	1.0 dB/km	0.5 dB/km

13. When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," the average change in attenuation over the rated temperature range of the cable shall not exceed 0.05 dB/km at 1550 nm for single-mode fiber. The magnitude of the maximum attenuation change of each individual fiber shall not be greater than 0.15 dB/km at 1550 nm.

14. Fiber Dispersion (maximum):

    1285-1330-nm 3.2-ps/nm*km
    @ 1550-nm 18-ps/nm*km

15. No single mode optical fiber shall show a point discontinuity greater than 0.1 dB at the specified wavelengths. Such a discontinuity or any discontinuity showing a reflection at that point shall be cause for rejection of that fiber by the Owner.

2.4 STATION CABLES

A. General

B. The Station Cable System is based on the installation of Un-shielded Twisted Pair (UTP) DATA Category 6 copper cables to install from the work area to the wiring hub locations(s). Refer to the Floor plan Drawings(s) which identify the location of the wiring hubs and Standard Information Outlets (SIO) locations.

C. Station Cables shall be constructed of individually twisted pairs with 24-AWG insulated solid copper conductors.

D. All Cables and Termination hardware shall be technically compliant with and installed in accordance with the referenced TIA/EIA documents.

E. All cables shall be suitable for installation in the environment defined and shall have the appropriate NEC rating.

F. Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits) of the National Electrical Code and shall meet the specifications of NEMA (low loss), UL 444, and ICEA.

G. Pairs of all 4-pair cables shall be unshielded and shall be identified by a banded color code in which conductor insulation is marked with a dominant color and banded with a contrasting color. By pair number, the pair colors or dominant band are:

1. Pair 1: Tip - White/Blue; Ring - Blue (or Blue/White)
2. Pair 2: Tip - White/Orange; Ring - Orange (or Orange/White)
3. Pair 3: Tip - White/Green; Ring - Green (or Green/White)
4. Pair 4: Tip - White/Brown; Ring - Brown (or Brown/White)

H. All Station Cables shall terminate on modular Category 6 Patch Panels in their respective Telecommunications Rack (TR) as specified on the drawings.

I. All cables, termination components and support hardware shall be furnished, tested, installed and wired by the Contractor.

J. Transmission characteristics of the Station Cables shall meet full Category 6 performance criteria as defined by the referenced TIA/EIA documents. Refer to the

Execution Section which details the required performance criteria of the completed Link of which the Cable is a part.

K. IMPORTANT: Cable and Termination Components (Jack, Patch Panel, Wiring Blocks) are specified to function as a System. The compatibility of the Cable to be installed with the proposed termination components shall be recognized and documented by the Termination Component Manufacturer.

L. The jacket color for Station Cables shall be **BLUE**.

M. Cable shall be packaged in a way that minimizes tangling and kinking of the cable during installation. Examples are open reels or packages that incorporate a rotating reel.

N. Cables installed in a Plenum area shall be Plenum rated.

2.5 STANDARD INFORMATION OUTLET

A. Station cables shall each be terminated at their designated workstation location in the connector types described in the sub-sections below. These connector assemblies shall snap into a mounting frame and exit at an angle. All ports shall be installed such that the opening faces the floor. The combined assembly is referred to as the Standard Information Outlet (SIO).

B. SIO mounting configurations shall be as follows:

1. Flush in new and existing boxes.
2. Flush mounted in Systems Furniture (base panel)
3. Surface mounted only where specifically noted on the drawings.

C. The SIO Frame shall accommodate:

1. Minimum of four (4) Modular Jacks, Fiber Optic Connectors and/or Coaxial Connectors.
2. The outlet frame shall incorporate a mechanism for adjusting the surface plate to a plumb position.

D. The same orientation and positioning of Jacks and Connectors shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each SIO type.

E. SIO Faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.

F. All Jacks and Connectors shall be fitted with a dust cover. Modular Jacks shall incorporate a dust cover that fits over and/or into the jack opening. The dust cover shall be designed to remain with the jack assembly when the jack is in use. No damage to the Jack pinning shall result from insertion or removal of these covers. Dust covers, which result in deformation of the jack pinning, shall not be accepted.

G. The faceplate of the SIO shall be constructed of High Impact Plastic. Faceplate color shall be **IVORY**. Confirm faceplate color and material with Owner prior to ordering faceplates.

H. Wall-mounted SIO's identified on the Floorplan Drawings to accommodate a wall-mounted telephone set shall have a wall plate made from Stainless Steel construction,

and accommodate one (1) SIO. Mount on a standard single gang outlet box and include mating lugs for wall phone mounting.

I. All Standard Information Outlets shall be of the same manufacturer throughout the project. An allowable exception, however, is the Wall-mounted telephone set SIO described above.

J. SIO Jacks

1. SIO jacks shall be an 8-pin Modular Jack.
2. The interface between the jack and the station cable shall be a 110-Style block or insulation displacement type contact. Termination components shall be designed to maintain the cable's pair twists as closely as possible to the point of mechanical termination
3. SIO Jacks shall be pinned TIA/EIA T568A.
4. Transmission characteristics of the SIO Jacks shall be as required to meet the TIA/EIA Category 6 performance criteria. Refer to the Execution Section which details the required performance criteria of the completed Link of which the Jacks are a part.
5. The Jack shall be UL verified and listed.
6. Jack contacts shall have a minimum of 50 micro-inches of gold plating.
7. The color of the SIO Jack shall be **IVORY**.

2.6 PATCH PANEL

A. Station cabling shall be terminated at the Main Equipment Rack on panels incorporating Modular Jacks meeting the specifications for the SIO's detailed in the Section above (with the exception that the jack openings shall be vertical, not angled downward).

B. At the Main Equipment Rack the patch panels shall be rack mounted.

C. The Patch Panel shall consist of a Modular to 110-type connector system. Modular jacks shall meet the specifications detailed above (NON-KEYED 8-pin).

D. The largest single patch panel configuration shall not exceed 72 ports. Panels which are modular shall be fully populated (all ports occupied by jacks) and be provided in increments of no less than 12-jacks. High density patch panel configurations must incorporate station cable management systems sized to accommodate the quantity of patch panel jacks being installed. Provide sufficient quantity of Patch Panels to terminate SIO's shown plus 20% spare jacks.

E. The Patch Panel blocks shall have the ability to seat and cut 8 conductors (4 pairs) at a time and shall have the ability of terminating 22- through 26-gauge plastic insulated, solid and stranded copper conductors. Data blocks shall be designed to maintain the cable's pair twists as closely as possible to the point of mechanical termination.

F. The Patch Panel as a system (including jack, cable interface and intermediate components) must maintain Category 6 performance per the referenced TIA/EIA documents. All pair combinations must be considered, with the worst-case measurement being the basis for compliance.

G. Panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to insure that all manufacturers minimum bend radius specifications are adhered to.

H. The Patch Panel shall have color coded designation strips to identify cable count.

I. Transmission performance shall be maintained by the Patch Panel as a system (including jack, cable interface and intermediate components).

2.7 VOICE BACKBONE TERMINATION FIELD

A. At the Telecommunications Rack, each Voice "Backbone" Cable shall be terminated on high density horizontal 110 blocks. Wall mounted terminal blocks must be mounted on a prepared surface consisting of 5/8 inch plywood securely fastened to the building walls. All six surfaces of the plywood must be painted with fire retardant paint.

B. Note that 110 blocks are only allowed for the Cat. 3 backbone. 110 blocks are not acceptable for Cat. 6 cables under any circumstance.

C. Each horizontal row of the cross-connect block must be capable of terminating one (1) twenty-five pair binder group (Backbone Cables). Backbone blocks shall be segregated clearly identifying their function.

D. The mechanical termination shall:

1. Have the ability of terminating 22 - 26 AWG plastic insulated, solid and stranded copper conductors.
2. Provide a direct connection between the cable and jumper wires.
3. Have less than 0.2-dB of attenuation from 1 - 16 MHz.
4. Have less than 100 milli-Ohm of DC resistance.
5. Have less than 5 milli-Ohm of resistance imbalance.
6. Have minimal signal impairments at all frequencies up to 16 MHz.

E. Blocks shall identify pair position by a color designation - Blue, Orange, Green, Brown and Slate (Backbone only).

F. The blocks shall be designed to maintain the cable's pair twists as closely as possible to the point of mechanical termination.

G. The Voice Termination Hardware shall be 110-style.

1. Voice Backbone Cabling Termination
2. Five (5) Pair Termination Clips (e.g. C5) shall be used in the termination of Voice Backbone Cabling

H. Horizontal Troughs incorporating plastic distribution rings shall be provided by the Contractor to accommodate routing of jumpers. Troughs shall be positioned at the top of each column of termination blocks and between each 100-pair wiring block.

I. Vertical Troughs incorporating metal distributing rings shall be provided in the Entrance Room for vertical routing of jumper and/or cross-connect wire. In each telecommunication room, a backboard incorporating plastic distribution rings allowing for a change in direction in cross connect wiring shall be installed between the blocks on which station and backbone cabling are terminated.

2.8 EQUIPMENT RACK

A. Equipment Racks shall be furnished and installed by the contractor to house Cable Termination components (e.g. Copper Data and Fiber Optic) and Network Electronics (by others). Refer to the drawings for rack locations.

B. The rack shall conform to the following requirements:

1. The rack shall comply with State Building Codes for the seismic area in which it is to be installed.
2. Rack shall be 84" in height and shall be self-supporting.
3. Channel uprights shall be spaced to accommodate Industry standard 19" mounting.
4. Rack must be constructed of aluminum and have either a coating or painted surface.
5. Rack shall be double-side drilled and tapped to accept 12-24 screws. Uprights shall also be drilled on back to accept cable brackets, clamps, power strip(s), etc. Hole pattern on rack front shall be per EIA/TIA specifications (5/8"-5/8"-1/2"). Hole pattern on the rear shall be at 3" intervals to accept cable brackets
6. Rack should be supplied with a supply of spare screws (minimum of 24).
7. Base footprint should be no smaller than 15"x20".
8. Rack should be supplied with a ground bar and #6 AWG Ground lug.
9. Rack shall be equipped with lockable doors over entire rack.

C. Provide 12" cable runway to support the top of each equipment rack. Securely bolt the cable runway to the wall, and use J-bolts to connect the cable runway to the equipment rack.

D. Jumper Management

1. Rack shall be equipped with Vertical and Horizontal Jumper Management Hardware in the form of rings and guides, as to allow an orderly routing of twisted pair, optical fiber and coaxial jumpers from the patch panels to the customer provided network equipment. Jumper management hardware shall be as follows:

   a. Horizontal Jumper Management Panels shall be plastic (3.5" panel), have a minimum of five (5) Jumper distribution rings (1.75" x 3.75" minimum dimension).
   b. At minimum, horizontal cable management hardware shall be shall be positioned above and below (a) each grouping of two rows of Jacks Data Patch Panels and (b) above and below each Fiber Optic Patch Panel.
   c. Vertical jumper management shall provide for cable routing on front and rear of each rack and be 3½" square (minimum). Vertical Jumper Management hardware shall mount on spacers attached to the rack uprights and not on the upright itself. Where multiple racks are to be installed, this hardware shall be mounted between the uprights of adjacent racks. Rack uprights and the spacers shall be secured together per manufacturer recommendations.
   d. Each rack shall be supplied with a minimum of twelve (12) releasable (e.g. "hook & loop") cable support ties.

2.9 FLEXIBLE NONMETALLIC INNERDUCT AND FITTINGS

A. General

1. Flexible Non-metallic Innerduct (e.g. "Innerduct") shall be used as follows:

   a. To segment conduit(s), increasing their capacity.
   b. As protection to fiber optic cable(s) within Equipment Rooms and Telecommunications Rooms.

2. Innerduct shall be corrugated.

3. Where not installed in a continuous length, innerduct segments should be spliced using couplings designed for that purpose.
4. Any vacant innerduct shall be equipped with a pull cord and capped at all ends to inhibit the entry of water and contaminants.
5. Nominal duct size shall be 1-inch (minimum).
6. Innerduct should be rated (e.g. General, Flame-retardant, Riser or Plenum) as required by the installation environment. Riser and Plenum innerduct shall be of a color contrasting to that of the "Standard" and Flame-retardant innerduct. The preferred colors are Orange ("Standard & Flame-retardant) and White (Riser and Plenum). Note that plenum rated innerduct does not allow the cables inside the innerduct to not be plenum rated.

B. Plenum-rated Innerduct

1. Be fabricated of flame-retardant and smoke inhibiting materials suitable for installation in such environments, and

   a. Meet or exceed all requirements for flame propagation and emissions as specified by test method UL-910 and referenced by the National Electrical Code (NEC) Section 770-53 for listed optical fiber raceways being installed in ducts, plenums and other areas for environmental air, and
   b. Meet or exceed all requirements specified by the National Fire Protection Agency (NFPA) 90A and 262 for Plenum spaces. Testing for fire and smoke characteristics shall be per UL-910.

2. Cable inside Plenum rated Innerduct shall also be Plenum rated.

2.10 MISCELLANEOUS MATERIALS

A. Power Strip / Surge Suppressor

1. For each equipment rack, provide one (1) Power Strip / Surge Suppressor by the contractor to provide for powering of the network electronics (by others).
2. Power Strip / Surge Suppressor shall:

   a. Be rack mountable (19-inch rack).
   b. Be compliant with UL-1449, UL 1283 and UL-497A.
   c. Provide Transient suppression to 13,000-A. Protection shall be in all 3 modes (hot-neutral, hot-ground & neutral-ground).
   d. Shall meet or exceed IEEE 587 Category A & B specification.
   e. Provide High Frequency Noise Suppression as follows:

      >20-dB @ 50-kHz
      >40-dB @ 150-kHz
      >80-dB @ 1-MHz
      >30-dB @ 6- to 1000-MHz

   f. Provide a minimum of 320 Joules of AC Energy Absorption.
   g. Be equipped with a 12-foot power cord.
   h. Provide a minimum of six (6) outlets.

PART THREE - EXECUTION

3.1 GENERAL

A. Optical Fiber and Copper Pair counts of the cables to be supplied are detailed on the Drawings. Contractor shall furnish and install all cables, connectors and equipment as shown on drawings and as specified. It shall be noted that all cables shall be installed in continuous lengths from endpoint to endpoint. No splices shall be allowed unless noted otherwise.

B. Refer to Drawings which indicate the primary cable routes to follow and the termination location(s) within each building. Duct allocation shall be coordinated as part of the construction.

C. It is the contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified. This includes any modifications required to route and conceal horizontal distribution wiring.

D. Beginning installation means contractor accepts existing conditions.

E. Contractor shall furnish all required installation tools to facilitate cable pulling without damage to the cable jacket. Such equipment is to include, but not limited to, sheaves, winches, cable reels, cable reel jacks, duct entrance tunnels, pulling tension gauge and similar devices. All equipment shall be of substantial construction to allow steady progress once pulling has begun. Makeshift devices, which may move or wear in a manner to pose a hazard to the cable, shall not be used.

F. All cable shall be pulled by hand unless installation conditions require mechanical assistance. Where mechanical assistance is used, care shall be taken to insure that the maximum tensile load for the cable as defined by the manufacturer is not exceeded. This may be in the form of continuous monitoring of pulling tension, use of a "break-away" or other approved method.

G. The contractor will be responsible for identifying and reporting to the Site Coordinator(s) any existing damage to walls, flooring, tiles and furnishings in the work area prior to start of work. All damage to interior spaces caused by the installation of cable, raceway or other hardware must be repaired by the Contractor. Repairs must match preexisting color and finish of walls, floors and ceilings. Any contractor-damaged ceiling tiles are to be replaced by the contractor to match color, size, style and texture.

H. Where unacceptable conditions are found, the Contractor shall bring this to the attention of the construction supervisor immediately. A written resolution will follow to determine the appropriate action to be taken.

I. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all installation work. During pulling operation an adequate number of workers shall be present to allow cable observation at all points of duct entry and exit as well as the feed cable and operate pulling machinery.

J. Cable pulling shall be done in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 standards. Manufacturer's recommendations shall be a part of the cable submittal. Recommended pulling tensions and pulling bending radius shall not be exceeded. Any cable bent or kinked to radius less than recommended dimension shall not be installed. If any installed cable is kinked to a radius less than recommended dimension it shall be replaced by the contractor with no additional cost to the project.

K. All wiring shall be run in J-hooks, in conduit, in cable tray or in modular furniture as designated on the floorplan(s). All cable shall be free of tension at both ends.

L. Avoid abrasion and other damage to cables during installation.

M. Pulling Lubricant may be used to ease pulling tensions. Lubricant shall be of a type that is non-injurious to the cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.

N. The Cable system will be tested and documented upon completion of the installation as defined in this Section.

O. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

P. Should it be found by the Engineer, that the materials or any portion thereof, furnished and installed under this contract, fail to comply with the specifications and drawings, with the respect or regard to the quality, amount of value of materials, appliances or labor used in the work, it shall be rejected and replaced by the Contractor and all work distributed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.

Q. Fiber Optic Cable Installation

1. Cable slack shall be provided in each Backbone fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a common enclosure. Slack required in the various subsystems is as follows:
2. Backbone Intra-Building: A minimum of 5-meters (approx. 15-feet) of slack cable (each cable if applicable) shall be coiled and secured at one (1) end - preferably at the Entrance Room and/or Main Equipment Room. Cable slack installed other than at each end of cable run shall not be allowed.
3. Exact cable termination locations shall be field verified with Owner.
4. Backbone Fiber Optic Cable shall be installed in protective innerduct. This includes areas where the cable is routed in cable tray and where making a transition between paths (e.g. between conduit & cable tray or into equipment racks). The innerduct should extend into the termination and/or storage enclosure(s) at system endpoints.

R. Station Cabling

1. Station Cabling on each Floor shall be routed to the Telecommunications Rack (TR) on that floor or to the designated TR if on another floor.
2. Station cables shall be run to the SIO from the Telecommunications Rack serving each area supported by J-hooks.
3. The maximum station cable length shall not exceed 295-feet (90-meters) in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and must include any slack required for the installation and termination. The Contractor is responsible for installing station cabling in a fashion as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints should be identified and reported to the Engineer prior to installation. Changes to the plan shall be approved by the Engineer.
4. All cables shall be installed splice-free.

5. During pulling operation an adequate number of workers shall be present to allow cable observation at all points of duct entry and exit as well as the feed cable and operate pulling machinery.
6. Avoid abrasion and other damage to cables during installation.
7. All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellom grips may be used to spread the strain over a longer length of cable.
8. Where installed in J-hooks, installation shall consider the following:

    a. Cable shall run at right angles and be kept clear of other trades work.
    b. Cables shall be supported according to code utilizing "J-hook" supports anchored to ceiling concrete, piping supports or structural steel beams. J-hooks shall be designed to maintain cables bend to larger than the minimum bend radius.
    c. Supports shall be spaced at a maximum 4-foot interval unless limited by building construction. If cable "sag" at mid-span exceeds 6-inches, another support shall be used.
    d. Cable shall never be laid directly on the ceiling grid or attached in any manner to the ceiling grid wires.
    e. Cables shall not be attached to existing cabling, plumbing or steam piping, ductwork, ceiling supports or electrical or communications conduit.

9. Manufacturer's minimum bend radius specifications shall be observed in all instances.
10. Care should be taken in the use of cable ties to secure and anchor the station cabling. Ties should not be over tightened as to compress the cable jacket. No sharp burrs should remain where excess length of the cable tie has been cut.
11. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.
12. A coil of 4 feet in each cable shall be placed in the ceiling at the last support before the cables enter a fishable wall, conduit, surface raceway or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15-feet of slack shall be left in each station cable under 250-feet in length to allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.
13. At all Telecommunication Rooms (TR) , approximately 10-feet of slack shall be left in each station cable under 250-feet in length to allow for changes in the telecommunication room layout without re-cabling. These "service loops" shall be secured to the ladder rack, with "J" hooks above the equipment, racks, and patch panels and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.
14. To reduce or eliminate EMI, the following minimum separation distances from ≤480V Power lines shall be adhered to:

    a. Twelve (12) inches from power lines of <5-kVa.
    b. Eighteen (18) inches from high voltage lighting (including fluorescent).
    c. Thirty-nine (39) inches from power lines of 5-kVa or greater.
    d. Thirty-nine (39) inches from transformers and motors.

15. All openings shall be sleeved and firestopped per prevailing code requirements upon completion of cable installation.

16. IMPORTANT: Within the room in which Data Cabling is to be terminated, Hook and Loop(e.g. "Velcro") ties only shall be used from room entry to the point of termination. This is to facilitate the addition of future cables.

S. Standard Information Outlet

1. General

a. SIO's shall be flush mounted in recessed boxes, in Surface Raceway and in modular furniture as shown on the drawings.

b. Any outlets to be added where these conditions are not met shall be positioned at a height matching that of existing services or as directed otherwise by the Engineer. Nominal height (from finished floor to center line of SIO) in new installation shall be as follows:

1)	Standard Information Outlet	18-inches
2)	Wall-Mounted Telephone Outlet	46-inches.

3.2 INNERDUCT

A. Innerduct shall be riser or plenum rated as required by the installation environment. At minimum, innerduct should extend to the ladder rack above the termination enclosure at system endpoints. Where not installed in a continuous length, innerduct segments should be spliced using couplings designed for that purpose.

B. All exposed innerduct is to be labeled at 35-foot (minimum) intervals with tags indicating ownership, the cable type (e.g. "Fiber Optic Cable") and the cables it contains.

C. Where required by the project design, fiber optic cable shall be installed in protective innerduct.

D. Contractor shall determine optimum size and quantity to satisfy the requirements of the installation insure that the mechanical limitations - including Minimum Bend Radius - of the cable are considered.

E. The innerduct should extend into the termination enclosure at system endpoints.

F. Where not installed in a continuous length, innerduct segments should be spliced using couplings designed for that purpose.

3.3 CABLE TERMINATION

A. General

1. At the Telecommunications Rack, all Station Cables shall be positioned on termination hardware in sequence of the Outlet I.D. starting with the lowest number.

B. Cable Termination – Cat. 6 Station Cable UTP

1. Patch Panels shall be designed and installed in a fashion as to allow future station cabling to be terminated on the panel without disruption to existing connections.
2. Patch panels shall be sized to accommodate a minimum of 20% growth in the quantity of stations relative to the initial installation.

3. At SIO's and Patch Panels, the installer shall insure that the twists in each cable pair are preserved to within 0.5-inch of the termination. The cable jacket shall be removed only to the extent required to make the termination.

C. Cable Termination - Fiber Optic

1. All fibers shall be terminated using the specified connector type.
2. Fibers shall be positioned consecutively and mapped "position for position" between patch panels. There shall be no transpositions in the cabling.
3. Connectors from two cables shall never share a common coupling panel. Multi-mode and single mode optical fibers (where applicable) shall be segregated on the panels as to clearly identify the distinction between the fiber types.
4. All terminated fibers at the Telecommunications Rack shall be mated to couplings mounted on patch panels. Couplings shall be mounted on a panel that, in turn, snaps into the housing assembly. Any unused panel positions shall be fitted with a blank panel inhibiting access to the fiber optic cable from the front of the housing.
5. All couplings shall be fitted with a dust cap.
6. Fibers from multiple locations may share a common enclosure, however, they must be segregated on the connector panels and clearly identified. Fibers from multiple destinations may be secured in a common enclosure provided that they are clearly identified as such. Fibers from different locations shall not share a common connector panel (e.g. "insert").
7. Slack in each fiber shall be provided as to allow for future re-termination in the event of connector or fiber end-face damage. Adequate slack shall be retained to allow termination at a 30" high workbench positioned adjacent to the termination enclosure(s). A minimum of 1-meter (~39") of slack shall be retained regardless of panel position relative to the potential work area.
8. Where "Loose Buffered" cables are installed, the 250um coated fibers contained in these cables may be terminated either by 1) splicing of factory terminated cable assemblies ("pigtails") or 2) the use of a "fan-out" kit. In the latter approach, individual fiber are to be secured in a protective covering, an Armid (e.g. Kelvar) reinforced tube for example, with connectors mated to the resulting assembly. In both instances, the proposed termination hardware shall incorporate a mechanism by which cable and sub assemblies are secured to prevent damage. Splicing shall be by the "fusion" method. Individual splice loss shall not exceed 0.3 dB for multi-mode fibers and 0.1 dB for single mode fibers (if applicable). Direct termination of 250 um coated fibers shall not be permitted.

D. Equipment Rack (Free Standing)

1. The Contractor shall bolt the rack to the floor as recommended by the manufacturer. Multiple racks shall be joined and the ground made common on each. Rack shall also be stabilized by installing cable runway extending to the wall. Alternately, overhead cable tray over which the cabling accesses the equipment rack(s) shall provide this function.
2. A space between the rack upright and the wall (~4") should be planned to allow for cabling in that area. The rear of the rack should be ~40" from the wall to allow for access by maintenance personnel. In all cases, a minimum of 40" workspace in front of the rack is also required. Locations where these guidelines cannot be followed should be brought to the attention of the Engineer for resolution prior to installation.
3. All hardware and equipment is to be mounted between 18" and 79" above floor level.
4. Equipment Rack shall be equipped with cable management hardware on both the front and back of rack as to allow an orderly and secure routing of twisted

pair cabling to the data patch panels. At minimum, one such Horizontal Jumper Management Panel shall be placed below each Fiber Optic Patch Panel installed by the Contractor. Additional Jumper Management panels may be required pending installation of other cable types on the rack.

5. The rack(s) shall be grounded to the Telecommunications Ground Busbar (TGB) using a #6 AWG (or larger) insulated stranded copper conductor (GREEN jacket or GREEN jacket with one or more yellow stripes). (See NEC, section 250.)

E. Identification and Labeling

1. SIO's shall be labeled according to the following: [Telecom Room]-[Floor]-[Outlet number].
2. Example: TR1-2-46 represents Telecom Room number one, second floor, outlet number 46.
3. All Copper Backbone and Station Cables, Outlet Faceplates and Termination components (e.g. Patch Panel) shall be clearly labeled.
4. All labels shall be machine generated, black capital letters on a white background. Install labels under clear protective covers on SIO faceplates and patch panels.
5. Prior to installation, the Contractor shall provide samples of all label types planned for the project. These samples shall include examples of the lettering to be used.

F. Cooperation

1. The Contractor shall cooperate with other trades and State personnel in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the work to better fit the general installation, such work shall be done at no extra cost to the State, provided such decision is reached prior to actual installation. The Contractor shall check the location of electrical outlets with respect to other installations before installing.
2. The contractor shall cooperate with the Section 27 15 01 Telecommunications Commissioning contractor.

3.4 TESTING AND ACCEPTANCE

A. General

1. The contractor is responsible to perform acceptance tests as indicated below for each sub-system (e.g. backbone, station, etc.) as it is completed.
2. All tests shall be documented.
3. The Contractor is responsible for supplying all equipment and personnel necessary to conduct the acceptance tests.
4. The Contractor shall visually inspect all cabling and termination points to insure that they are complete and conform to the wiring pattern defined herein. The contractor shall provide the Engineer with a written certification that this inspection has been made
5. The Contractor shall conduct acceptance testing according to a schedule coordinated with the General Contractor and Owner. Representatives of the Owner may be in attendance to witness the test procedures. The contractor shall provide a minimum of one (1) week advance notice to the Owner as to allow for such participation. The notification shall include a written description of the proposed conduct of the tests including copies of blank test result sheets to be used.

6. IMPORTANT: Failure to provide the above information shall be grounds for the Owner/Engineer to reject any and all Documentation of Results on related testing and to require a repeat of the affected test.
7. Tests related to connected equipment of others shall only be done with the permission and presence of Contractor involved. The Contractor shall ascertain that testing only as required to prove the wiring connections are correct.
8. The Contractor shall provide test results and describe the conduct of the tests including the date of the tests, the equipment used and the procedures followed. At the request of the Engineer, the contractor shall provide copies of the original test results.
9. All cabling shall be 100% fault free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of the contractor. The applicable tests shall then be repeated.
10. Should it be found by the Engineer that the materials or any portion thereof furnished and installed under this contract fail to comply with the specifications and drawings, with the respect or regard to the quality, amount of value of materials, appliances or labor used in the work, it shall be rejected and replaced by the Contractor and all work distributed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.

B. Coordination with Section 27 15 01 Communications Commissioning Contractor

1. This project includes a separate Communications Commissioning Contractor. The scope of work for the Communications Commissioning Contractor is specified in Section 27 15 01.
2. The Section 27 15 00 contractor shall complete all work and testing indicated in this section. Submit test results to the Section 27 15 01 contractor for review. Copy the Engineer and Owner on all transmittals (including documents) to the Section 27 15 01 contractor. If the Section 27 15 01 contractor finds any work not in conformance with the specifications or has a test result that fails, the Section 27 15 00 shall correct the condition, retest and resubmit the test information to the Section 27 15 01 contractor. If the Section 27 15 01 contractor finds a repeated failure of the same item, the Section 27 15 00 contractor will reimburse the Section 27 15 01 contractor $200 per Cat. 6 or fiber pair test until the item is corrected. The Engineer will resolve all disputes between the Section 27 15 00 and Section 27 15 01 contractors.
3. All work shall be done to the satisfaction of the Section 27 15 01 contractor, the Engineer and the Owner.

C. Station Cabling (Category 6)

1. Testing shall be from the Jack at the SIO to the Patch Panel at the TR on which the cables are terminated. The cabling must pass all Cat 6 TIA requirements.
2. Station cables shall be free of shorts within the pairs, and be verified for continuity, pair validity and polarity, and Wire Map (Conductor Position on the Modular Jack). Any defective, split or mis-positioned pairs must be identified and corrected.
3. Testing of the Cabling Systems rated at TIA Category 6 shall be performed to confirm proper functioning and performance.

D. Category 6 Performance Testing

1. In addition to the above, Performance Testing shall be performed on all cables. Testing of the Transmission Performance of station cables (Category 6) shall include the following:

    a. Length
    b. Attenuation
    c. Pair to Pair NEXT Loss (new limits)
    d. PSNEXT Loss
    e. Pair to Pair ELFEXT Loss (Equal Level Far End Cross-talk)
    f. PSEFEXT Loss
    g. Propagation Delay
    h. Delay Skew
    i. Return Loss

2. Cables shall be tested to the maximum frequency defined by the standards covering that performance category. Transmission Performance Testing shall be performed using a test instrument designed for testing to the specified frequencies. Test records shall verify "PASS" on each cable and display the specified parameters - comparing test values with standards based "templates" integral to the unit.
3. Testing shall be per ANSI/TIA/EIA 568B.2 Permanent Link test configurations and ANSI/TIA/EIA 568B.2 Category 6.
4. The maximum length of station cable shall not exceed 90 meters which allows 10 meters for equipment and patch cables. Worst case performance at 20°C, based on a Horizontal Cable length of 90 meters and Equipment Cord length of 4 meters, shall be as follows:

E. Category 6 Test Parameters:

	Category 6 Cable Permanent Link Test					
Frequency	TIA/EIA 568B.2-1 Insertion Loss Attenuation	TIA/EIA 568B.2-1 NEXT Worst Pair to Pair	TIA/EIA 568B.2-1 PSNEXT Worst Case Loss	TIA/EIA 568B.2-1 ELFEXT Worst Pair to Pair Loss	TIA/EIA 568B.2-1 PSELFEXT Loss	TIA/EIA 568B.2-1 Return Loss
Mhz	Max. dB	dB	dB	DB	dB	dB
1.00	1.9	65.0	62.0	64.2	61.2	19.1
4.00	3.5	64.1	61.8	52.1	49.1	21.0
8.00	5.0	59.4	57.0	46.1	43.1	21.0
10.00	5.5	57.8	55.5	44.2	41.2	21.0
16.00	7.0	54.6	52.2	40.1	37.1	20.0
20.00	7.9	53.1	50.7	38.2	35.2	19.5
25.00	8.9	51.5	49.1	36.2	33.2	19.0
31.25	10.0	50.0	47.5	34.3	31.3	18.5
62.50	14.4	45.1	42.7	28.3	25.3	16.0
100.00	18.6	41.8	39.3	24.2	21.2	14.0
200.00	27.4	36.9	34.3	18.2	15.2	11.0
250.00	31.1	35.3	32.7	16.2	13.2	10.0

F. Propagation Delay

1. The maximum propagation delay determined in accordance with the ANSI/TIA/EIA –568B.2 for a Permanent Link configuration shall be less than 498-ns measured at 10MHz. (Note: In determining the permanent link propagation delay, the propagation delay contribution of connecting hardware is assumed to not exceed 2.5 ns from 1 MHz to 100MHz).

G. Delay Skew

1. For all frequencies from 1 MHz to 250 MHz, Category 6 cable propagation delay skew shall not exceed 44ns/100m at 20 degrees C, 40 degrees C, and 60 degrees C. In addition, the propagation delay skew between all pairs shall not vary more than +/- 10ns from the measured value at 20 degrees C when measured at 40 degrees C and 60 degrees C. Compliance shall be determined using a minimum 100m of cable.
2. In order to establish testing baselines, cable samples of known length and of the cable type and lot installed shall be tested. The cable may be terminated with an 8-position Category 6 Modular plug (8-pin) to facilitate testing. Net Propagation Velocity (NPV) and nominal attenuation values shall be calculated based on this test and be utilized during the testing of the installed cable plant. This requirement can be waived if NPV data is available from the cable manufacturer for the exact cable type under test.
3. In the event results of the tests are not satisfactory, the Contractor shall make adjustments, replacement and changes as are necessary, and shall then repeat the test or tests which disclosed faulty or defective material, equipment or installation method, and shall make additional tests as the Engineer deems necessary at no additional expense to the project or Owner.

H. Fiber Optic Cable

1. General

a. The fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by the Owner, the Contractor shall provide cable manufacturer's test report for each reel of cable provided. These test reports shall include (1) manufacturer's on the reel attenuation test results at the specified wavelengths for each optical fiber of each reel prior to shipment from the manufacturer and (2) on-the-reel Bandwidth performance as tested at the factory.

2. Tests After Installation

a. Upon completion of cable installation and termination, the Fiber Optic cabling shall be tested to include:

1) Optical Attenuation ("Insertion Loss" Method)
2) Verification of Link Integrity (OTDR)

3. Optical Attenuation Testing

a. Optical Attenuation shall be measured on all terminated optical fibers in both directions of transmission using the "Insertion Loss" method. Measurement shall be inclusive of the optical connectors and couplings installed at the system endpoints. 100 foot access jumpers shall be used at both the transmit and receive ends to insure that an accurate measurement of connector losses is made.

b. Multi-mode fibers shall be tested in accordance with the EIA/TIA 526-14A, Method B at 850±30 nm. Single mode fibers (if applicable) shall be tested in accordance with the EIA/TIA 526-7-1998. Method A.1. Testing shall be at 1300±20 nm.

c. Attenuation of optical fibers shall not exceed the values calculated at follows:

1) Attenuation (max.) = 2*C+L*F+S dB
2) Where C is the maximum allowable Connector Loss (in dB), L is the length of the run (in kilometers) and F is the maximum allowable fiber loss (in dB/km). S is the total splice loss (# of splices * max. attenuation per splice).

4. OTDR Testing

a. All fibers even those that are left unterminated (if applicable) shall be documented in one direction of transmission using an Optical Time Domain Reflectometer (OTDR). Multi-mode fibers shall be tested at 850-nm (nominal). Single mode fibers (if applicable) shall be tested at 1300nm (nominal). The OTDR(s) shall incorporate high-resolution optics optimized for viewing of short cable sections. Access jumpers of adequate length to allow viewing of the entire length of the cable, including the connectors at the launch and receive end, shall be used.

b. OTDR traces revealing a point discontinuity greater than 0.2-dB in a multi-mode fiber, or 0.1-dB in a single mode fiber (if applicable) at any of the tested wavelengths or any discontinuity showing a reflection at that point shall be a valid basis for rejection of that fiber by the Owner. The installation of that cable shall be reviewed in an effort to remove any external stress that may be causing the fault. If such efforts do not remove the fault, that cable and the associated terminations shall be replaced at the expense of the contractor.

5. RG-6 - Testing

a. A Time Domain Reflectometer (TDR) shall be used to verify cable length and to test for cable faults and breaks. A step-function high resolution Time Domain Reflectometer shall be employed for this test, such as the Tektronix 1502C or the Hewlett-Packard 1415A. The results shall be automatically plotted on an X-Y plotter with a Y axis voltage reflection coefficient resolution of .001 per division. The X axis will resolve down to 1" of cable. The TDR will sweep the cable at a rate no greater than 50' per second, or such lower rate as necessary to resolve cable faults to the 1" and .001 VRC level.

b. The cables shall be terminated with its characteristic impedance, and in the case of 70-75 ohm cable, an appropriate matching pad shall be used to match the analyzer to the cable. Cable shall be rejected if any single fault is observed of amplitude greater than .003 voltage reflection coefficient. Characteristic impedance shall also be measured at 5% of nominal value.

c. Cyclic faults (such as cable reel stress and tie drawdown) shall be limited to a voltage reflection coefficient of .005.

6. Shielded Cabling (T1) - Testing

a. Shielded "T1" Cables shall be free of conductor-to-conductor and conductor-to-shield shorts.

b. All pairs shall be verified for continuity, pair validity and polarity and conductor position on the termination blocks (e.g. 110). Any mis-positioned pairs must be identified and corrected, and retested again

c. Shield and Drain wire continuity shall also be verified.

3.5 DOCUMENTATION

A. General

1. Upon completion of the installation, the contractor shall provide three (3) full Documentation Sets to the Engineer for review. Documentation shall include the items detailed in the sub-sections below.
2. Documentation of Test Results shall be submitted in hard copy and in electronic form (pdf format). Electronic documents shall be submitted on CD-ROM.
3. Documentation shall be submitted within ten (10) working days of the completion of each testing phase (e.g. subsystem, cable type, area, floor, etc.). This is inclusive of all test result and draft as-built drawings. Draft drawings may include annotations done by hand. Computer generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase.

B. Test Data - Copper Media

1. Test results shall include a record of test frequencies, cable type, conductor pair and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).

C. Test Data - Fiber Optic Media

1. Test results shall include a record of test wavelengths, cable type, fiber (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).

2. OTDR traces of individual optical fiber "signatures" obtained as specified above shall be provided to the A/E for review. Trace files shall be so named as to identify each individual fiber by location in the cable system and fiber number or color.
3. IMPORTANT: Where paper copy documentation of OTDR traces is provided, the vertical and horizontal scales shall be set as to maximize the detail in each backscatter trace. The portion of the trace which depicts the fiber under test shall extend a minimum of 50% of the display area.

END SECTION 27 15 00

SECTION 27 15 01 – COMMISSIONING OF COMMUNICATIONS CABLE AND EQUIPMENT

PART ONE - GENERAL

1.1 SCOPE

A. This section includes the commissioning requirements for communications systems.

1.2 COMMISSIONING INTENT

A. The intent of this section is to ensure that all installed work described in Section 16741 meets the specified requirements. This will be determined by the review of the installing contractor's test results and by testing performed by this section contractor of all communication systems.

1.3 DEFINITIONS

A. Communications: All the work in Section 27 15 00.

B. Commissioning: The process of ensuring that systems are installed, functionally tested and capable of being used in conformity with the design intent.

C. Commissioning Contractor: This section contractor.

1.4 QUALITY ASSURANCE

A. The commissioning contractor shall be a company specializing in communications testing with a minimum of five years documented experience and completed four jobs of the magnitude specified in Section 27 15 00.

B. The commissioning contractor shall have a BICSI certified technician review the test results and perform the testing required by this section. This technician shall have a minimum of five years experience in similar communications work.

C. The commissioning contractor shall be a subcontractor directly to the General Contractor.

D. The commissioning contractor shall not be related in any way to the Section 27 15 00 contractor.

E. This section contractor shall study and be thoroughly familiar with Section 27 15 00.

1.5 RELATED WORK AND REQUIREMENTS

A. Work of Related Sections:

1. Section 01 33 00: Submittals
2. Section 27 15 00: Communications Cable and Equipment

1.6 REGULATORY REFERENCES

A. The commissioning contractor will review the installed communications systems with regard to the following regulatory references:

B. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the Wisconsin Electrical Code and present manufacturing standards.

C. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

D. Other applicable standards are as follows:

1. ANSI/IEEE C2 - National Electrical Safety Code
2. NFPA 70- 2005 - National Electrical Code
3. Comm. Chapter 16 - Wisconsin Electrical Code
4. TIA/EIA Standards 526-14A (OFSPT-14A), 526-7 (OFSPT-7), 568B.2 (Category 6), 568B.3, 569A, 606A, and 607 (with exception)
5. IEEE/ANSI 142-1982 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
6. ICEA publication S-80-576-2002

1.7 COORDINATION

A. During the project and warranty period, coordinate commissioning of the communications system with the General Contractor, Section 27 15 00 Contractor, Engineer, the respective user group(s), and the City of Madison Information Services department.

B. All correspondence between the commissioning contractor and the Section 27 15 00 contractor shall be copied to the General Contractor, Owner and Engineer.

1.8 SUBMITTALS

A. Include the following items along with bid. Not including these documents with bid will be grounds for rejection of bid.

1. Name and documentation of the contractor's BICSI certified technician who will be performing the work in this specification.
2. Signed letter with brief description of companies services and number of years in business performing said services.
3. Listing of at least four projects of similar magnitude to this project.
4. Signed letter stating that the company is independent from the General Contractor and the Section 27 15 00 contractor.

1.9 WARRANTY

A. The Section 27 15 00 contractor is required to warrant the Fiber Optic cable and Cat. 6 systems for fifteen (15) years. The Section 27 15 01 contractor will participate in any warranty claims for the same time period as stated below.

B. In the event of a warranty claim, the Owner will contact the Section 27 15 01 contractor first to review the item of concern. If corrective action is required, the Section 27 15 00 contractor will receive direction from the Section 27 15 01 contractor, and then perform the necessary work to correct the situation. The Section 27 15 00 contractor will then test the work to show conformance with this specification section. Test results will be

submitted to the Section 27 15 01 contractor for review. All aspects of PART THREE – EXECUTION in this section will be followed until the Owner accepts the corrected work.

1.10 REVIEW OF TEST RESULTS WITH OWNER'S PERSONNEL

A. Include one hour meeting with Owner to review test results. Meeting to be held during normal working hours. Schedule review meeting with the Owner two weeks in advance.

PART TWO - PRODUCTS

Not used.

PART THREE - EXECUTION

3.1 REVIEW OF SECTION 27 15 00 CONTRACTOR TEST RESULTS

A. The Section 27 15 00 contractor will submit their test results to the Section 27 15 01 contractor for review. The commissioning contractor shall review the submittal and ensure that all documents are in compliance with Section 27 15 00. If the documents are not complete or do not meet Section 27 15 00 requirements, return the documents to the Section 27 15 00 contractor for correction and resubmittal clearly noting the deficiencies.

3.2 COMMUNICATIONS COMMISSIONING

A. After the Section 27 15 00 contractor test results are acceptable, the Section 27 15 01 contractor will perform their own independent tests. These tests shall follow Section 27 15 00, Part 3, Execution requirements.

B. If the Section 27 15 01 contractor finds any work not in conformance with the specifications, instruct the Section 27 15 00 contractor to correct the condition, retest and resubmit the test information to the Section 27 15 01 contractor. The Section 27 15 01 contractor will then retest the item. If the Section 27 15 01 contractor finds a repeated failure of the same item, the Section 27 15 00 contractor will reimburse the Section 27 15 01 contractor $200 per Cat. 6 or fiber pair test until the item is corrected.

3.3 SUBMITTING TEST RESULTS

A. Upon completion of all testing with positive results, assemble test results in both hard copy and pdf format on CD. Submit 3 sets of test results for Engineer review. Refer to Section 27 15 00 for test submittal requirements.

B. All documentation, including hard copy and electronic forms shall become the property of the City of Madison.

3.4 CERTIFICATION LETTER

A. The commissioning contractor shall submit to the Engineer a letter certifying that all Section 27 15 00 work is complete and performs as specified.

END SECTION 27 15 01

SECTION 28 31 00 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes fire alarm systems for the following:

1. Replacement of existing fire alarm system.
2. Supplementary (not required) coverage in areas indicated.
3. Partial coverage for areas indicated.

B. Related Sections include the following:

1. Division 8 Section "Hardware" for door closers and holders with associated smoke detectors, electric door locks, and release devices that interface with the fire alarm system.

1.3 DEFINITIONS

A. AFF: Above Finished Floor.

B. FACP: Fire alarm control panel.

C. LED: Light-emitting diode.

D. NICET: National Institute for Certification in Engineering Technologies.

E. U.N.O.: Unless Noted Otherwise.

F. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

G. Authority having Jurisdiction (AHJ)

1.4 SYSTEM DESCRIPTION

A. Noncoded, addressable system; multiplexed signal transmission dedicated to fire alarm service only.

B. Noncoded, analog-addressable system; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.

1.5 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 72.

B. Premises protection includes remodeling and additions of existing facility.

C. Fire alarm signal initiation shall be by one or more of the following devices:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Verified automatic alarm operation of smoke detectors.
5. Automatic sprinkler system water flow.
6. Fire extinguishing system operation.
7. Duct smoke detectors.

D. Fire alarm signal shall initiate the following actions:

1. Alarm notification appliances shall operate continuously.
2. Identify alarm at the FACP and remote annunciators.
3. De-energize electromagnetic door holders.
4. Transmit an alarm signal to the remote alarm receiving station.
5. Unlock electric door locks in designated egress paths.
6. Release fire and smoke doors held open by magnetic door holders.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
8. Close smoke dampers in air ducts of system serving zone where alarm was initiated.
9. Record events in the system memory.
10. Record events by the system printer.

E. Supervisory signal initiation shall be by one or more of the following devices or actions:

1. Operation of a fire-protection system valve tamper.

F. System trouble signal initiation shall be by one or more of the following devices or actions:

1. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
2. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at the FACP.
4. Ground or a single break in FACP internal circuits.
5. Abnormal ac voltage at the FACP.
6. A break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at the FACP or annunciator.

G. System Trouble and Supervisory Signal Actions: Ring trouble bell and annunciate at the FACP and remote annunciators. Record the event on system printer.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Shop Drawings shall be prepared by persons with the following qualifications:

   a. Trained and certified by manufacturer in fire alarm system design.
   b. Fire alarm certified by NICET, minimum Level III.

2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
3. Device Address List: Coordinate with final system programming.
4. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
6. Batteries: Size calculations.
7. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
8. Ductwork Coordination Drawings: Plans, sections, and elevations of ducts, drawn to scale and coordinating the installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, the detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
9. Voice/Alarm Signaling Service: Equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
10. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. Qualification Data: For Installer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual. Include abbreviated operating instructions for mounting at the FACP.

F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review. Include all fees required for any submittals in electrical bid.

G. Documentation:

1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and authorities having jurisdiction.
2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.

   a. Hard copies on paper to Owner.

b. Electronic media may be provided to Architect and authorities having jurisdiction.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Work of this Section be performed by a UL-listed company.

C. Installer Qualifications: Personnel certified by NICET as Fire Alarm Level III.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 PROJECT CONDITIONS

A. Existing Fire Alarm Service: Existing fire alarm system is reported to be not operating. Provide temporary protection as required.

1. Notify Fire Department, Construction Manager, Owner., Owner's Insurance Carrier, Supervisors and the Alarm Company regarding proposed interruption of fire alarm service.
2. Do not proceed without Construction Manager's written permission.
3. Provide an impairment tag and locate the tag as required by the Fire Department.

1.9 SEQUENCING AND SCHEDULING

A. Existing Fire Alarm Equipment: Existing system is reported to be not operating. Provide temporary protection as required by AHJ. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: Remove existing disconnected fire alarm equipment.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below 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 not less than 1 unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
3. Smoke and Fire: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less 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: One of each type installed.
7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. FACP and Equipment:

a. Simplex equipment is preferred for this project and shall be included in base bid. Equipment by other manufacturers may be listed as a add or deduct to the base bid.
b. Edwards Systems Technology Inc.
c. Faraday, LLC.
d. NOTIFIER; a GE-Honeywell Company.
e. Siemens Building Technologies, Inc.

2. Wire and Cable: (As recommended by equipment mfg.)

a. Comtran Corporation.
b. Helix/HiTemp Cables, Inc.; a Draka USA Company.
c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
d. West Penn Wire/CDT; a division of Cable Design Technologies.

2.2 EXISTING FIRE ALARM SYSTEM

A. Remove completely from site.

2.3 FACP

A. General Description:

1. Simplex 4010 system equipment.
2. Modular, power-limited design with electronic modules, UL 864 listed.
3. Addressable initiation devices that communicate device identity and status.

a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at the FACP.
b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

4. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP 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, [one] [two] [three] line(s) of [40] [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. Signaling Line Circuits: NFPA 72, Class B.

a. System Layout: Install no more than 50 addressable devices on each signaling line circuit.

2. Notification-Appliance Circuits: NFPA 72, Class B.
3. Actuation of alarm notification appliances, annunciation, shall occur within 10 seconds after the activation of an initiating device.
4. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.

D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm verification" signal at the FACP.
2. Activate a listed and approved "alarm verification" sequence at the FACP and the detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel FACP indication and system reset if the alarm is not verified.

E. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41.

F. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.

G. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP[and remote annunciators,] after initiating devices are restored to normal.

1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

H. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.

I. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and control of changes in those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector

groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and make a print-out of the final adjusted values on the system printer.

J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter and telephone lines.

K. Service Modem: Ports shall be RS-232 for system printer and for connection to a dial-in terminal unit.

1. The dial-in port shall allow remote access to the FACP for programming changes and system diagnostic routines. Access by a remote terminal shall be by encrypted password algorithm.

L. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble), and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including the same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

M. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, [supervisory signal] [supervisory and digital alarm communicator transmitter] [and] [digital alarm radio transmitter] shall be powered by the 24-V dc source.

1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
2. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with "FIRE ALARM SYSTEM POWER."

N. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.

1. Batteries: Sealed lead calcium.
2. Battery and Charger Capacity: Comply with NFPA 72.

O. Surge Protection:

1. Install surge protection on normal ac power for the FACP and its accessories. Comply with Division 16 Section "Transient Voltage Suppression" for auxiliary panel suppressors.
2. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.

P. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE ALARM BOXES

A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on

recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, breaking-glass or plastic-rod type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. General Description:

1. UL 268 listed, operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
3. Multipurpose type, containing the following:

    a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
    b. Piezoelectric sounder rated at 88 dBA at 10 feet according to UL 464.
    c. Heat sensor, combination rate-of-rise and fixed temperature.

4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating [detector has operated] [and power-on] status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

    a. Rate-of-rise temperature characteristic shall be selectable at the FACP for 15 or 20 deg per minute.
    b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at the FACP to operate at 135 or 155 deg F.
    c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

C. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:

    a. Sensor: LED or infrared light source with matching silicon-cell receiver.

b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

2. UL 268A listed, operating at 24-V dc, nominal.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.

   a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.

5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where indicated.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
8. Each sensor shall have multiple levels of detection sensitivity.
9. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
10. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 NONSYSTEM SMOKE DETECTORS

A. Single-Station Smoke Detectors:

1. UL 217 listed, suitable for NFPA 101, Section 9.6.2.9 occupancies, operating at 120-V ac[, with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device].
2. Auxiliary Relays: One Form [C rated at 0.5 A] [A and 1 form C, both rated at 0.5 A].
3. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet according to UL 464.
4. Visible Notification Appliance: 177 candela strobe.
5. Heat sensor, 135 deg F [combination rate-of-rise and] fixed temperature.
6. Test Switch: Push-to-test, simulates smoke at rated obscuration.
7. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
8. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
9. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
10. Integral Visual-Indicating Light: LED type. Indicating [detector has operated] [and power-on] status.

2.7 HEAT DETECTORS

A. General: UL 521 listed.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.8 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.

C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.

1. Rated Light Output: Candela as indicated on drawings.
2. Strobe Leads: Factory connected to screw terminals.
3. Strobes shall be synchronized.

D. Horn/Strobe: Combination device as described in paragraph E and F above.

2.9 SPRINKLER SYSTEM REMOTE INDICATORS

A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the tamper switch or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.10 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Verify requirements with General Contractor.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
2. Wall-Mounted Units: Flush mounted, unless otherwise indicated.
3. Rating: 24-V ac or dc.
4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.11 REMOTE ANNUNCIATOR

A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Class 1.

B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.12 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal [to the elevator controller to initiate elevator recall] [to a circuit-breaker shunt trip for power shutdown] <Insert other functions>.

2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Listed and labeled according to UL 632.

B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.

C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.

D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.14 SYSTEM PRINTER

A. Listed and labeled as an integral part of the fire alarm system.

2.15 GUARDS FOR PHYSICAL PROTECTION

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of the device.
2. Finish: Paint of color to match the protected device.

2.16 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG or size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70 Article 760, Classification CI, for power-limited fire alarm signal service. UL listed as Type FPL, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.
3. Multiconductor Armored Cable: NFPA 70 Type MC, copper conductors, TFN/THHN conductor insulation, copper drain wire, copper armor[with outer jacket] with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Smoke or Heat Detector Spacing:

1. Smooth ceiling spacing shall not exceed [30 feet] [the rating of the detector].
2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.

B. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.

D. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

E. 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.

F. Audible/Visual and Visual Only Alarm-Indicating Devices: Install such that the entire lens is not less than 80" AFF or not greater than 96" AFF. Devices shall all be mounted at the same elevation throughout project, U.N.O. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

G. Device Location-Indicating Lights: Locate in public space near the device they monitor.

H. FACP: Surface mount with tops of cabinets not more than 72 inches above the finished floor.

I. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.2 WIRING INSTALLATION

A. Install wiring according to the following:

1. NECA 1.
2. TIA/EIA 568-A.

B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes for Electrical Systems."

1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of 2-hour fire-rated fire alarm cables, NFPA 70 Types MI and CI, is permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Common Work Results for Electrical."

B. Install instructions frame in a location visible from the FACP.

C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.4 GROUNDING

A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections[, and to assist in field testing]. Report results in writing.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

D. Perform the following field tests and inspections and prepare test reports:

1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.

    a. Include the existing system in tests and inspections.

3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
4. Testing: Follow procedure and record results complying with requirements in NFPA 72.

    a. Detectors that are outside their marked sensitivity range shall be replaced.

5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.

C. Semiannual Test and Inspection: Six months after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

D. Annual Test and Inspection: One year after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, semiannual, and annual periods. Use forms developed for initial tests and inspections.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1 Section "Demonstration and Training." Certify in writing that the new fire alarm system is complete, tested, demonstrated to Owner and is in perfect operating condition.

END OF SECTION 28 31 00

SECTION 31 05 00 - EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. This section includes earthwork as shown on drawings and as follows:

1. Preparation and grading of subgrade for slabs-on-grade, walks, pavements and landscaping.
2. Excavating and backfilling for buildings and structures.
3. Drainage fill course for support of slabs-on-grade.
4. Subsurface drainage backfill for walls and trenches.
5. Excavating and backfilling of trenches within building lines.
6. Excavating and backfilling of trenches outside of building lines.
7. Excavating and backfilling for underground sewerage utilities and appurtenances.

B. Related sections:

1. Division 3 Section "Concrete Work" for concrete footings, walls, foundations and slabs-on-grade.
2. Division 32 Section "Planting and Lawns" for placing and preparing topsoil for lawns and plantings.
3. Division 33 Section for "Foundation Drainage."

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

1.4 PROJECT CONDITIONS:

A. Site Information:

1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that the Architect and Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for convenience of Contractor.
2. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

B. Existing Utilities:

1. Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
3. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when permitted in writing by Architect and then only after acceptable temporary utility services have been provided.
4. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

C. Use of Explosives: The use of explosives is not permitted.

D. Protection of Persons and Property:

1. Barricade open excavations occurring as part of this work and post with warning lights.
2. Operate warning lights as recommended by authorities having jurisdiction.
3. Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS:

A. Definitions:

1. Satisfactory soil materials are defined as those complying with American Association of State Highway and Transportation Officials (AASHTO) M145, soil classification Groups A-1, A-2-4, A-2-5 and A-3; and complying with ASTM D-2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
2. Unsatisfactory soil materials are those defined in AASHTO M145 soil classification Groups A-2-6, A-2-7, A-4, A-5, A-6 and A-7; and ASTM classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
3. Subbase Material (Engineered Fill): Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand, ASTM D 2940, with at least 95 percent passing a 1-1/2 inch sieve and not more than 12 percent passing a No. 200 sieve.
4. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448, coarse aggregate grading size 57; with 100 percent passing a 1-1/2 inch sieve and not more than 5 percent passing a No. 8 sieve.
5. Bedding: Naturally or artificially grade mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1 inch sieve and not more than 8 percent passing a No. 200 sieve.
6. Backfill and Fill Materials: Satisfactory soil materials free of clay, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Cold Weather Protection: Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.2 DEWATERING:

A. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.

B. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines and other dewatering system components necessary to convey water away from excavations.

C. Convey water removed from excavations and rainwater to collecting or run-off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.

3.3 EXCAVATION:

A. Excavation consists of removal and disposal of material encountered when establishing required finish grade elevations.

B. Excavation Classifications: The following classifications of excavation will be made when unanticipated rock excavation is encountered in work. Do not perform such work until material to be excavated has been cross sectioned and classified by Architect. Such excavation will be paid on basis of contract conditions relative to changes in work.

1. Earth excavation includes removal and disposal of pavements and other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, material of any classification indicated in data on subsurface conditions and other materials encountered that are not classified as rock excavation or unauthorized excavation.

C. Unauthorized Excavation:

1. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be at Contractor's expense.
2. Under footings, foundation bases or retaining walls fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Architect.
3. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Architect.

D. Additional Excavation:

1. When excavation has reached required subgrade elevations, notify Architect who will examine conditions.
2. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by Architect.
3. Removal of unsuitable material and its replacement as directed will be paid on basis of contract conditions relative to changes in work.

E. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

F. Shoring and Bracing:

1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
2. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.
3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses. Provide permanent steel sheet piling or pressure creosote timber sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures. Cut off tops as required and leave permanently in place.

3.4 MATERIAL STORAGE:

A. Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.

B. Locate and retain soil materials away from edge of excavations.

C. Dispose of excess soil material and waste materials as herein specified.

3.5 EXCAVATION FOR STRUCTURES:

A. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction and for inspection.

B. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.

C. For pile foundations, stop excavations from 6 inches to 12 inches above bottom of footing before piles are placed. After piles have been driven, remove loose and displaced material and excavate to final grade, leaving solid base to receive concrete pile caps.

3.6 EXCAVATIONS FOR WALKS AND PAVEMENTS:

A. Excavate surface under walks and pavements to comply with cross sections, elevations and grades as shown.

3.7 EXCAVATION FOR UTILITY TRENCHES:

A. Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room.

B. Excavate trenches to depths, gradients, lines , and elevations indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.

C. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.

3.8 BACKFILL:

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities and record documents.
3. Inspecting and testing of underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.9 UTILITY TRENCH BACKFILL:

A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Backfill trenches excavated under footings and within 18 inches of bottom of footings; fill with concrete to elevation of bottom of footings.

C. Provide 4-inch thick, concrete base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

D. Place and compact initial backfill of subbase material, free of particles larger than 1-inch, to a height of 12 inches over the utility pipe or conduit. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utility testing.

F. Fill voids with approved backfill materials while shoring and bracing, and sheeting is removed.

G. Place and compact final backfill of satisfactory materials to final subgrade.

3.10 FILL:

A. Ground Surface Preparation:

1. Remove vegetation, debris, unsatisfactory soil materials, obstructions and deleterious materials from ground surface prior to placement of fills. Plow, strip or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.
2. When existing ground surface has a density less than that specified under "Compaction" for particular area classification break up ground surface, pulverize, moisture condition to optimum moisture content and compact to required depth and percentage of maximum density.

B. Placement of Fill:

1. Place backfill and fill 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.
2. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen or contain frost or ice.
3. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying material uniformly around structure to approximately same elevation in each lift.

C. General: Place acceptable soil material in layers to required subgrade elevations for each area classification listed below.

1. In excavations, use satisfactory excavated or borrow soil material.
2. Under grassed areas, use satisfactory excavated or borrow soil material.
3. Under walks, pavements and curb and gutter, use subbase material.
4. Under steps and ramps, use subbase material.
5. Under building slabs, use drainage fill material.
6. Under footings and foundations, use subbase material.

3.11 MOISTURE CONTROL:

A. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material to prevent free water appearing on surface during or subsequent to compaction operations.

B. Remove and replace or scarify and air dry soil material that is too wet to permit compaction to specified density.

C. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.12 COMPACTION:

A. General: Control soil compaction during construction providing minimum percentage of density specified for each area classification.

B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum dry density for soils which exhibit a well-defined moisture density relationship determined in accordance with ASTM D 1557.

1. Structures: Compact top 12 inches of subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
2. Building Slabs and Steps: Compact top 12 inches of subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
3. Lawn or Unpaved Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material at 90 percent maximum dry density.
4. Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
5. Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material at 95 percent maximum dry density.

3.13 GRADING:

A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.

C. Finish surfaces free from irregular surface changes and as follows:

1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.
2. Walks: Shape surface of areas under walks to line, grade and cross section, with finish surface not more than 0.10 foot above or below required subgrade elevation.
3. Pavements: Shape surface of areas under pavement to line, grade and cross section, with finish surface not more than 1/2 inch above or below required subgrade elevation.

D. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified and to required elevation. Provide final grades within a tolerance of 1/2 inch when tested with a 10 foot straightedge.

E. Compaction: After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

3.14 PAVEMENT SUBBASE COURSE:

A. General: Subbase course consists of placing subbase material in layers of specified thickness over subgrade surface to support a pavement base course.

B. Grade Control: During construction, maintain lines and grades including crown and cross slope of subbase course.

C. Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least a 12 inch width of shoulder simultaneously with compacting and rolling of each layer of subbase course.

D. Placing: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.

E. When a compacted subbase course is shown to be 6 inch thick or less, place material in a single layer. When shown to be more than 6 inch thick, place material in equal layers, except no single layer more than 6 inch or less than 3 inch in thickness when compacted.

3.15 BUILDING SLAB DRAINAGE COURSE:

A. General: Drainage course consists of placement of drainage fill material, in layers of indicated thickness, over subgrade surface to support concrete building slabs.

B. Placing: Place drainage fill material on prepared subgrade in layers of uniform thickness, conforming to indicated cross section and thickness. Maintain optimum moisture content for compacting material during placement operations. When a compacted drainage course is shown to be 6 inch thick or less, place material in a single layer. When shown to be more than 6 inch thick, place material in equal layers, except no single layer more than 6 inch or less than 3 inch in thickness when compacted.

3.16 FIELD QUALITY CONTROL:

A. Quality Control Testing During Construction: Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed.

1. Perform field density tests in accordance with ASTM D 1556 (sand cone method) or ASTM D 2922 (nuclear method), as applicable.
2. Footing Subgrade: For each strata of soil on which footings will be placed, conduct at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to Architect.
3. Paved Areas and Building Slab Subgrade: Make at least one field density test of subgrade for every 2000 sq. ft. of paved area or building slab, but in no case less than 3 tests. In each compacted fill layer make one field density test for every 2000 square feet of overlaying building slab or paved area, but in no case less than 3 tests.
4. Foundation Wall Backfill: Take at least 2 field density tests at locations and elevations as directed.

B. If in opinion of Architect based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense.

3.17 PROTECTION:

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and reestablish grades in settled, eroded and rutted areas to specified tolerances.

C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape and compact to required density prior to further construction.

3.18 DISPOSAL OF EXCESS AND WASTE MATERIALS:

A. Removal to Designated Areas on Owner's Property:

1. Transport acceptable excess excavated material to designated soil storage areas on Owner's property. Stockpile soil or spread as directed by Architect.
2. Transport waste material, including unacceptable excavated material, trash and debris to designated spoil areas on Owner's property and dispose of as directed.

B. Removal from Owner's Property:

1. Remove waste materials, including unacceptable and/or excess excavated material, trash and debris and dispose of it off Owner's property.

END SECTION 31 05 00

SECTION 31 40 00 - SHORING AND UNDERPINNING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. Include all materials, labor, services and incidentals necessary for the completion of this section of the work.

B. Work generally includes reinforced concrete underpinning to support exposed edges of existing footings. Extent of the underpinning is shown on the contract drawings.

1.3 REFERENCES:

A. Referenced codes and standards including all revisions and commentaries shall be the most currently adopted as of the date of these contract documents.

B. Comply with all provisions of the following codes and standards except as modified herein.

1. American Concrete Institute (ACI)

   a. ACI 301 Specifications for Structural Concrete for Buildings.
   b. ACI 318 Building Code Requirements for Reinforced Concrete.
   c. ACI 315 Details and Detailing of Concrete Reinforcement.

2. Concrete Reinforcing Steel Institute (CRSI)

   a. Manual of Standard Practice.
   b. Recommended Practice for Placing Reinforcing Bars.

3. American Society For Testing And Materials (ASTM)

   a. Specific ASTM numbers are noted in later text.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Concrete:

1.	Compressive Strength	3000 PSI
2.	Maximum Aggregate Size	3/4 inch
3.	Maximum Slump	5 inches ± 1inch

B. Reinforcing Steel:

1. Shall conform to ASTM A-615, Grade 60

C. Non-Shrink Grout:

1. Shrinkage-resistant grout where noted on the drawings or where thickness is greater than 1 inch shall be non-shrink, non-metallic grout, pre-mixed, factory-packaged complying with Corps of Engineers CRD-C621 Specifications. The following are approved:

a. Master Flow 713: Master Builders
b. Five Star Grout: US Grout Corporation
c. Sonogrout: Sonneborn Building Products
d. Set Non-Shrink: Set Products, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Excavation under footing shall be performed with extreme care so as to not undermine any excess areas.

B. Underpinning procedures are defined on the contract drawings.

C. During excavation if the Contractor feels that the specified underpinning is not required or that extra underpinning is required because of visually inspected soil conditions, he shall notify the A/E to review the existing site conditions. The A/E will determine whether any changes will be made and appropriate change orders will be written by him based on the unit price on the bid form.

END OF SECTION 31 40 00

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This work shall consist of constructing sidewalks, crosswalks, driveways, traffic islands and steps of concrete masonry, with or without reinforcement, placed on the prepared foundation or base in one (1) course of the required dimensions and design; all as shown on the plans and provided by the contract.

B. Where integral curb and sidewalk is specified, such work shall consist of a sidewalk constructed with a concrete curb built integral with the same, all in accordance with the design and details shown on the plans.

C. The following specifications pertain equally to concrete sidewalks, concrete driveways, concrete traffic islands, and concrete steps, whether the particular item of construction is mentioned or not.

1.2 REFERENCES

A. Wisconsin Department of Transportation Standard Specifications for Highway and Structure Construction, Latest Edition (WDOT).

PART 2 - PRODUCTS

2.1 CONCRETE REQUIREMENTS

A. All requirements under Section 033000, Cast-In-Place Concrete, for mix design, high early strength concrete, tests, materials, mixing, placing, curing and protection of the concrete shall apply to concrete used in the construction of concrete sidewalks, concrete driveways, concrete traffic islands, and steps of concrete masonry.

2.2 EQUIPMENT

A. Equipment and tools necessary for performing all parts of the work shall be satisfactory as to design, capacity, and mechanical condition for the purposes intended, and any equipment which is not maintained in full working order, or which, as used by the Contractor, is inadequate to obtain the results prescribed shall be repaired, improved, replaced or supplemented to obtain the progress and workmanship contemplated by the contract.

2.3 SELECT FILL

A. WDOT Section 301 Base Aggregate Dense ¾ inch.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. Preparation of Foundation

1. The foundation shall be formed by excavating or filling to the required elevation of the bottom of the concrete. The foundation so constructed shall be thoroughly mechanically compacted to insure stability. The foundation shall be thoroughly moistened immediately prior to placing of the concrete. When a sidewalk is built in excavation, the foundation shall be made sufficiently wide to permit placing of forms and performing the required work of placing the concrete and finishing. All objectionable material below the bottom of the excavation shall be removed and replaced with satisfactory material. All excavated material not necessary for banking the completed sidewalk shall be removed from the work before the work shall have been deemed to have been completed. Slopes of the excavation shall be one foot (1') vertical to one foot (1') horizontal unless otherwise ordered by the Engineer.
2. When a sidewalk is built on fill, the foundation shall be constructed to a width two feet (2') wider than the proposed sidewalk, extending one foot (1') beyond each edge of the sidewalk. The fill shall be constructed of approved materials. Slopes of the fill shall be one foot (1') vertical to two feet (2') horizontal unless otherwise order by the Engineer.
3. Where expressly ordered by the Engineer, select foundation shall be placed under the sidewalk and shall be paid for at the unit price bid for Select Fill. Select fill so installed shall be mechanically impacted.
4. The Contractor shall be responsible for replacement with approved materials, mechanically compacted, of any material necessary to bring the subbase to grade, where he has undercut the subbase without the direction of the Engineer.
5. Where tree roots are found to be in the same location of new sidewalk or sidewalk that is to be removed and replaced, the roots shall be removed to a minimum depth of five inches (5") below the subgrade.

B. Forms

1. Sidewalk forms shall be of steel construction and have a vertical height of at least five inches (5"). Wooden forms may be used only with the Engineer's approval on short radius curves and in special cases where accessibility is limited.
2. All forms shall be free of hardened concrete, mud, dirt, and debris, and shall be free of bends and twists which would make their use on the project unacceptable.
3. All forms shall be oiled, to the satisfaction of the Engineer, before depositing or placing concrete in them.
4. When concrete sidewalk is constructed on a curve, flexible forms shall be used for all curves having a radius of two hundred linear feet (200 l.f.) or less.

C. Placing and Finishing Concrete

1. The foundation and forms, and reinforcement when required, shall be checked and approved by the Engineer before the concrete is placed. The concrete shall be placed on a moist foundation, deposited to the required depth, and consolidated and spaded sufficiently to bring the mortar to the surface, after which it shall be struck off and floated with a wooden float. Before the mortar has set, the surface shall be steel troweled until a smooth surface is obtained, sloping uniformly between side forms and transverse joints.
2. The concrete at the faces of all joints shall be thoroughly spaded and compacted to fill the voids and the surface shall be finished smooth and true to grade in a manner as hereinbefore provided. The edges of the sidewalk along forms, joints and metal slab division forms shall be finished with a steel edging tool of one-fourth inch (1/4") radius.
3. The Contractor may, with prior approval of the Engineer, elect to use a machine for placing, forming and consolidating concrete sidewalk. If a machine is used, the resulting sidewalk shall be of such quality as to equal or exceed that produced by methods hereinbefore described.
4. Any honeycombed areas occurring along the forms shall be filled with mortar immediately following the removal of the forms.
5. The Contractor shall install a header at the end of each pour. At no time will the Contractor be allowed to spread excess concrete as a base for the next or any succeeding pour.

Minimum length blocks of 4'-6" (4-1/2 feet) may be poured only at the end of a day's pour and then only with permission of the Engineer.

D. Joints

1. Unless otherwise directed by the Engineer, the sidewalk shall be cut into blocks five feet (5') in length.
2. Transverse joints shall be constructed at right angles to the centerline of the sidewalk and longitudinal joints shall be constructed parallel to the centerline of the walk, unless otherwise provided. The joints shall be constructed as laid out in the field by the Engineer. Whenever the entire area between the back of the curb and the right-of-way or lot line, such sidewalk shall be constructed in alternate sections extending from the back of the curb to the permanent structure and such sections shall not exceed twelve linear feet (12 l.f.) or sidewalk length. When the alternate sections placed in the first operation have been cured as specified, the intervening sections shall be placed to complete the walk.
3. No joint shall deviate more than five degrees (5 deg) from a position perpendicular to the surface of the finished sidewalk, nor shall the axis of any joint deviate more than one-half inch (1/2") either way from a straight line or from the designated alignment at any point. If the joints are constructed in sections, there shall be no offsets or concrete struts between adjacent units.
4. When the sidewalk is constructed in partial width slabs, transverse joints in adjacent slabs shall be placed in line with like joints in the previously constructed slabs. In the case of sidening existing sidewalks, transverse joints shall be paced in line with like joints in the existing sidewalk.
5. Insofar as feasible, sidewalks shall be divided into sections not less than five feet (5') nor more than twelve feet (12') in any dimension. The unit areas shall be produced by use of metal slab division forms extending to the full depth of the concrete, or when so approved by the Engineer, by contracting joints as defined hereinafter.
6. A contraction joint in a sidewalk shall consist of a slot or groove, at least one inch (1"0 in depth and one-fourth inch (1/4)" in width, formed by inserting a metal parting strip in the concrete after it has been struck off and consolidated and while the concrete is still plastic. As soon as the concrete will retain its shape, the parting strip shall be removed and the joint edge-finished.
7. When approved by the Engineer, contraction joints at least one inch (1") in depth and approximately one-eighth inch (1/8") in width may be sawed in the concrete sidewalk. The sawing shall be done as soon as practicable after the concrete has set sufficiently to preclude raveling during the sawing and before any shrinkage cracking takes place in the concrete.
8. At intervals of approximately 96 feet (96') on continuous sidewalk construction, and at the ends of all radii, one-half inch (1/2") expansion joint filler shall be placed. Whenever the walk abuts on or is adjacent to the curb, one inch (1") expansion joint filler shall be placed between the curb and the sidewalk. Crosswalks and aprons at intersections shall have one-half inch (1/2") expansion joint filler placed between the crosswalk or apron and the Owner's sidewalk.
9. Expansion joint filler shall extend to the full depth and width of the concrete and the top shall be slightly below the finished surface of the sidewalk. Joints shall not be sealed.

E. Reinforcement

1. Where reinforcement is required, it shall conform to and be placed in accordance with the details shown on the plans, as specified in the contract, or as directed by the Engineer.
2. The Contractor shall install three (3), one-half inch (1/2"), round reinforced rods fifteen feet (15') long in concrete sidewalks which span ditches.

F. Protection

1. The sidewalk must be protected from injury by traffic or other causes and also from the rays of the sun until completely set. Sidewalks may be opened to pedestrian traffic after expiration of the curing period.

G. Replacement of Concrete Sidewalk

1. At such places and for such distances as shall be designated by the Engineer, the Contractor shall replace concrete sidewalks by breaking up and removing all old material, and preparing the existing foundation for the construction of the concrete sidewalk. Upon the foundation so prepared, the Contractor shall construct a concrete sidewalk in accordance with the foregoing specifications. The cost of removal of all old concrete material shall be included in the amount bid per square foot of sidewalk replacement unless otherwise specified in the contract.

H. Contractor's Identification

1. The Contractor shall stamp or otherwise show his name and the year constructed on the sidewalk constructed or reconstructed for the Owner. Such identification shall be stamped at the beginning and end of each section of the project.

I. Backfilling and Restoring the Site of the Work

1. Where the sidewalk does not abut curb, gutter, pavement or other structures, and when the concrete in such sidewalk has been cured and the forms removed, the spaces along the sides shall be backfilled with satisfactory soil and thoroughly compacted. The backfill shall conform to the section shown on the plans. The Contractor shall dispose of surplus excavation offsite and shall restore the site of the work to a neat and workmanlike condition.

J. Concrete Sidewalks

1. Concrete sidewalks and crosswalks shall be five inches (5") in thickness, five feet (5') in width, constructed of non-reinforced concrete, with a transverse slope of one-fourth inch (1/4") per foot, unless otherwise noted on the plans or in the special provisions of the contract, or unless otherwise directed by the Engineer.
2. Where directed by the Engineer, all existing sidewalk in the terrace between the curb and public sidewalk that is removed during the construction of new curb and gutter shall be replaced in the same location and to the same dimensions as was true of the original terrace walks.

K. Concrete Driveways

1. Concrete driveways shall be seven inches (7") in thickness and constructed of non-reinforced concrete unless otherwise noted on the plans or in the Special Provisions of the contract. Expansion joints and contraction joints shall conform to the requirements of Section 07920, except that the Contractor may cut diagonal joints in order to control the cracking of the concrete in the curved areas of commercial drives.

L. Concrete Traffic Islands

1. Traffic islands shall be constructed at the locations and in accordance with the design, dimensions and details shown on the plans.

M. Steps of Concrete Masonry

1. When construction of steps is included in the contract, they shall be built at the locations and in accordance with the design, dimensions and details shown on the plans. The work shall include reinforcement and necessary excavation, backfilling and disposal of excess material from excavation.

END OF SECTION 32 13 13

SECTION 32 13 73 - CONCRETE PAVING 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. This Section includes the following:

1. Expansion and contraction joints within cement concrete pavement.
2. Joints between cement concrete and asphalt pavement.

B. Related Sections include the following:

1. Division 7 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch-wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. 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 or manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 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.
2. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
3. When joint substrates are wet or covered with frost.
4. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
5. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, 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. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 COLD-APPLIED JOINT SEALANTS

A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.

1. Available Products:

a. Crafco Inc.; RoadSaver Silicone.
b. Dow Corning Corporation; 888.

B. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

1. Available Products:

a. Crafco Inc.; RoadSaver Silicone SL.
b. Dow Corning Corporation; 890-SL.

2.4 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.5 PRIMERS

A. Primers: Product 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.

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.

1. 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.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on 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.

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 backer materials of type 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 backer materials.
2. Do not stretch, twist, puncture, or tear backer materials.
3. Remove absorbent backer materials 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 provided for 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 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 sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved 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 and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 32 13 73

SECTION 32 17 23 - PAVEMENT MARKINGS

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. This Section includes the following:

1. Pavement-marking paint.

B. Related Sections include the following:

1. Division 32 Section "Concrete Paving" for concrete paving.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international graphics symbol, spaces dedicated to people with disabilities.

C. Qualification Data: For manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

PROJECT CONDITIONS

A. Environmental Limitations: Do not apply pavement marking materials if finish paving is wet or excessively damp.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 PAVEMENT MARKING MATERIALS

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than 5 minutes.

1. Color: To match existing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that paved surface is dry and in suitable condition.

B. Proceed with paving marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.3 DISPOSAL

A. Except for material indicated to be recycled, remove marking materials, application materials, containers and all surplus from Project site and legally dispose of them in an approved landfill.

END OF SECTION 32 17 23

SECTION 32 90 00 - PLANTING AND LAWNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 DESCRIPTION OF WORK:

A. This section includes the following:

1. Shrubs
2. Topsoil and soil amendments
3. Fertilizers and mulches
4. Restoration of existing lawn

B. Related sections:

1. Division 31 Section: Excavation, filling and grading required to establish elevations shown on drawings.

1.3 QUALITY ASSURANCE:

A. Subcontract landscape work to a single firm specializing in landscape work.

B. Source Quality Control:

1. General: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
2. Do not make substitutions. If specified landscape material is not obtainable, submit to Architect proof of nonavailability and proposal for use of equivalent material. When authorized, adjustment of contract amount will be made.
3. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
4. Topsoil: Before delivery of topsoil, furnish Architect with written statement giving location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped and crops grown during past 2 years.
5. Shrubs: Provide shrubs grown in a recognized nursery in accordance with good horticultural practice. Provide healthy, vigorous stock free of disease, insects, eggs, larvae and defects such as knots, sun-scald, injuries, abrasions or disfigurement.
6. Sizes: Provide shrubs of sizes shown or specified. Shrubs of larger size may be used if acceptable to Architect and if sizes of roots or balls are increased proportionately.
7. Inspection: Architect reserves right to inspect shrubs either at place of growth or at site before planting, for compliance with requirements for name, variety, size and quality.

1.4 SUBMITTALS:

A. Certification: Submit certificates of inspection as required by governmental authorities and manufacturer's or vendors certified analysis for soil amendments and fertilizer materials. Submit other data substantiating that materials comply with specified requirements.

B. Submit seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentage by weight and percentages of purity, germination and weed seed for each grass seed species.

C. Planting Schedule: Submit planting schedule showing scheduled dates for each type of planting in each area of site.

D. Maintenance Instructions: Submit typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work for one full year. Submit prior to expiration of required maintenance period(s).

1.5 DELIVERY, STORAGE AND HANDLING:

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

B. Sod: Time delivery so that sod will be placed within 24 hours after stripping. Protect sod against drying and breaking of rolled strips.

C. Shrubs: Provide freshly dug shrubs. Do not prune prior to delivery. Do not bend or bind-tie shrubs in such manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery.

D. Deliver shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set shrubs in shade, protect from weather and mechanical damage and keep roots moist.

E. Do not remove container grown stock from containers until planting time.

F. Label at least one shrub of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.

1.6 JOB CONDITIONS:

A. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.

B. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

C. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Architect before planting.

D. Planting Time: Plant or install materials during normal planting seasons for each type of landscape work required. Correlate planting with seed maintenance periods to provide maintenance from date of substantial completion.

E. Planting Schedule: Prepare a proposed planting schedule. Schedule dates for each type of landscape work during normal seasons for such work area of site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing after documentation of reasons for delays.

F. Coordination with Lawns: Plant shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to Architect. If planting of shrubs occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

1.7 SPECIAL PRODUCT WARRANTY:

A. Warranty lawns through specified maintenance period and until final acceptance.

B. Warranty shrubs: For a period of one year after date of substantial completion against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others or unusual phenomena or incidents which are beyond Landscape Installer's control.

C. Remove and replace shrubs or other plants found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period. Replace shrubs which are in doubtful condition at end of warranty period; unless, in opinion of Architect, it is advisable to extend warranty period for a full growing season.

D. Another inspection will be conducted at end of extended warranty period, if any, to determine acceptance or rejection. Only one replacement will be required at end of warranty period, except for losses or replacements due to failure to comply with specified requirements.

PART 2 - PRODUCTS

2.1 TOPSOIL:

A. Topsoil is, or will be stockpiled for reuse in landscape work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape work:

1. Provide new topsoil which is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter and free of roots, stumps, stones larger than 2 inches in any dimension and other extraneous or toxic matter harmful to plant growth.
2. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4 inches; do not obtain from bogs or marshes.

2.2 SOIL AMENDMENTS:

A. Lime: Natural limestone containing not less than 85 percent of total carbonates, ground so that not less than 90 percent passes a 10 mesh sieve and not less than 50 percent passes an 100 mesh sieve.

B. Peat Humus: FS Q-P-166 and with texture and pH range suitable for intended use.

C. Bonemeal: Commercial, raw, finely ground; 4 percent nitrogen and 20 percent phosphoric acid.

D. Superphosphate: Soluble mixture of treated minerals; 20 percent available phosphoric acid.

E. Commercial Fertilizer: Complete fertilizer of neutral character, with some elements derived from organic sources and containing following percentages of available plant nutrients:

1. For shrubs, provide fertilizer with not less than 10 percent available phosphoric acid and from 3 percent to 5 percent total nitrogen and from 3 percent to 5 percent soluble potash.
2. For lawns, provide fertilizer with not less than 4 percent phosphoric acid and not less than 2 percent potassium and percentage of nitrogen required to provide not less than 1 pound of actual nitrogen per 1000 square feet of lawn area. Provide nitrogen in a form that will be available to lawn during initial period of growth.

2.3 PLANT MATERIALS:

A. Quality: Provide shrubs and other plants complying with recommendations and requirements of ANSI Z60.1 "Standard for Nursery Stock" and as specified.

B. Deciduous Shrubs: Provide shrubs of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.

1. Provide bare root deciduous shrubs, except where shown as "B&B", provide balled and burlapped shrubs.

2.4 GRASS MATERIALS:

A. Contractor at Contractor's option may provide seeding or sodding to restore existing lawn area where disturbed by construction operations. Refer to the site plan in the drawings.

B. Grass seed: Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America. Provide seed of grass species, proportions and minimum percentages of purity, germination which is comparable to existing lawn area.

C. Sod: Provide strongly rooted sod, not less than 2 years old and free of weeds and undesirable native grasses. Provide only sod capable of growth and development when planted (viable, not dormant). Provide sod composed principally of grass species which is comparable to existing lawn area.

2.5 MISCELLANEOUS LANDSCAPE MATERIALS (As Needed):

A. Anti-erosion Mulch: Provide clean, seed free salt hay or threshed straw of wheat, rye, oats or barley.

B. Antidessicant: Emulsion type, film-forming agent designed to permit transpiration but retard excessive loss of moisture from plants. Deliver in manufacturer's fully identified containers and mix in accordance with manufacturer's instructions.

C. Plastic Sheet: Black, weather resistant polyethylene sheeting complying with FS L-P-512, Type III, 0.008 inch (8 mil) thick.

2.6 PREPARATION OF PLANTING SOIL:

A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps and other extraneous materials harmful or toxic to plant growth.

B. Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.

C. For pit and trench type backfill, mix planting soil prior to backfilling, and stockpile at site.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Layout individual shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Architect's acceptance before start of planting work. Make minor adjustments as may be requested.

B. Preparation for Planting Lawns:

1. Loosen subgrade of lawn areas to a minimum depth of 4 inches. Remove stones over 1-1/2 inches in any dimension and sticks, roots, rubbish and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.

    a. Spread planting soil mixture to minimum depth required to meet lines, grades and elevations shown, after light rolling and natural settlement.
    b. Place approximately 1/2 of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil.
    c. Allow for sod thickness in areas to be sodded.

2. Grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll and rake and remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.
3. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
4. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
5. Preparation of Unchanged Grades: Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading or stripping operations, prepare soil for lawn planting as follows: Till to a depth of not less than 6 inches; apply soil amendments and initial fertilizers as specified; remove high areas and fill in depressions; till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots and other extraneous matter.
6. Prior to preparation of unchanged areas, remove existing grass, vegetation and turf. Dispose of such material outside of Owner's property; do not turn over into soil being prepared for lawns.

C. Excavation for shrubs:

1. Excavate pits, beds and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.

   a. For bare root shrubs, make excavations at least 1 foot-0 inches wider than root spread and deep enough to allow for setting of roots on a layer of compacted backfill and with collar set at same grade as in nursery, but 1 inch below finished grade at site. Allow for 9 inch setting layer of planting soil mixture.
   b. For balled and burlapped (B&B shrubs), make excavations at least half again as wide as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill. Allow for 3 inch setting layer of planting soil mixture.
   c. For container grown stock, excavate as specified for balled 14 and burlapped stock, adjusted to size of container width and depth.

2. Dispose of subsoil removed from landscape excavations. Do not mix with planting soil or use as backfill.
3. Fill excavations for shrubs with water and allow to percolate out before planting.

3.2 PLANTING:

A. Planting shrubs:

1. Set balled and burlapped (B&B) stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around base and sides of ball and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.
2. Set bare root stock on cushion of planting soil mixture. Spread roots and carefully work backfill around roots by hand and puddle with water until backfill layers are completely saturated. Plumb before backfilling and maintain plumb while working backfill around roots and placing layers above roots. Set collar 1 inch below adjacent finish landscape grades. Spread out roots without tangling or turning up to surface. Cut injured roots clean; do not break.
3. Set container grown stock as specified for balled and burlapped stock, except cut cans on 2 sides with an approved can cutter; remove bottoms of wooden boxes after partial backfilling so as not to damage root balls.
4. Dish top of backfill to help hold water.
5. Mulch pits, trenches and planted areas. Provide not less than following thickness of mulch and work into top of backfill and finish level with adjacent finish grades.

   a. Provide 2 inch thickness of mulch.

6. Apply antidessicant using power spray to provide an adequate film over trunks, branches, stems, twigs and foliage.

   a. If deciduous shrubs are moved in full-leaf, spray with antidessicant at nursery before moving and again 2 weeks after planting.

7. Remove and replace excessively pruned or misformed stock resulting from improper pruning.

B. Seeding New Lawns:

1. Do not use wet seed or seed which is moldy or otherwise damaged in transit or storage.
2. Sow seed using a spreader or seeding machine. Do not seed when wind velocity exceeds 5 miles/hour. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
3. Sow not less than the quantity of seed specified or scheduled.
4. Rake seed lightly into top 1/8 inch of soil, roll lightly and water with a fine spray.
5. Protect seeded slopes against erosion with erosion netting or other methods acceptable to the Architect.
5. Protect seeded areas against erosion by spreading specified lawn mulch after completion of seeding operations. Spread uniformly to form a continuous blanket not less than 1-1/2 inch loose measurement over seeded areas. Anchor mulch by spraying with asphalt emulsion at the rate of 10 to 13 gallons per 1000 square foot. Take precautions to prevent damage or staining of construction or other plantings adjacent to mulched areas.

C. Sodding New Lawns:

1. Lay sod within 24 hours from time of stripping. Do not plant dormant sod or if ground is frozen.
2. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.
3. Anchor sod on slopes with wood pegs to prevent slippage.
4. Water sod thoroughly with a fine spray immediately after planting.

D. Reconditioning Existing Lawns:

1. Recondition existing lawn areas damaged by Contractor's operations including storage of materials and equipment and movement of vehicles. Also recondition existing lawn areas where minor re-grading is required.
2. Provide fertilizer, seed or sod and soil amendments as specified for new lawns and as required to provide a satisfactory reconditioned lawn. Provide new topsoil as required to fill low spots and meet new finish grades.
3. Cultivate bare and compacted areas thoroughly to provide a satisfactory, planting bed.
4. Remove diseased and unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations including oil drippings, stone, gravel and other loose building materials.
5. Where substantial lawn remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize and seed. Remove weeds before seeding or if extensive, apply selective chemical weed killers as required. Apply a seed bed mulch, if required, to maintain moist condition.
6. Water newly planted areas and keep moist until new grass is established.

3.3 MAINTENANCE:

A. Begin maintenance immediately after planting.

B. Shrubs:

1. Maintain shrubs until final acceptance but in no case less than following period:

a. 30 days after substantial completion of planting.

2. Maintain shrubs by pruning, cultivating and weeding as required for healthy growth. Spray as required to keep shrubs free of insects and disease.

C. Lawns:

1. Maintain lawns for not less than the period stated below and longer as required to establish an acceptable lawn.

a. Seeded lawns, not less than 60 days after substantial completion.
b. If seeded in fall and not given full 60 days of maintenance or if not considered acceptable at that time, continue maintenance following spring until acceptable lawn is established.
c. Sodded lawns, not less than 30 days after substantial completion.

2. Maintain lawns by watering, fertilizing, weeding, mowing, trimming and other operations such as rolling, regrading and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

3.4 CLEANUP AND PROTECTION:

A. During landscape work, keep pavements clean and work area in an orderly condition.

B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.

3.5 INSPECTION AND ACCEPTANCE:

A. When landscape work is completed, including maintenance architect will, upon request, make an inspection to determine acceptability.

B. Landscape work may be inspected for acceptance in parts agreeable to Architect provided work offered for inspection is complete including maintenance.

C. Where inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until reinspected by Architect and found to be acceptable. Remove rejected plants and materials promptly from project site.

END SECTION 32 90 00

SECTION 33 10 00 - WATER DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes piping and specialties for fire-protection water service outside the building.

B. Related Sections include the following:

1. Division 22 Section for potable-water piping inside the building.
2. Division 31 section for earthwork.

1.3 DEFINITIONS

A. The following are industry abbreviations for plastic and rubber materials:

1. NP: Nylon.
2. PE: Polyethylene.
3. PP: Polypropylene.
4. PTFE: Polytetrafluoroethylene.
5. PVC: Polyvinyl chloride.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Minimum Working Pressures: The following are minimum pressure requirements for piping and specialties, unless otherwise indicated:

1. Fire-Protection Water Service: 150 psig (1035 kPa).

1.5 SUBMITTALS

A. Product Data: For the following:

1. Pipe and fittings.
2. Valves.

B. Record Drawings: At Project closeout of installed water-service piping according to Division 1 Section "Contract Closeout."

1.6 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water-service piping specialties and are based on specific types and models indicated.

B. Comply with requirements of utility supplying water. Include tapping of water mains and backflow prevention.

C. Comply with standards of authorities having jurisdiction for fire-protection water-service piping. Include materials, hose threads, installation, and testing.

D. Comply with NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances," for materials, installations, tests, flushing, and valve and hydrant supervision.

E. Provide listing/approval stamp, label, or other marking on piping and specialties made to specified standards.

F. Listing and Labeling: Provide electrically operated specialties and devices specified in this Section that are listed and labeled.

G. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

H. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

B. Ensure that valves are dry and internally protected against rust and corrosion.

C. Protect valves against damage to threaded ends and flange faces.

D. Set valves in best position for handling. Set valves closed to prevent rattling.

E. During Storage: Use precautions for valves, including fire hydrants, according to the following:

F. Do not remove end protectors, unless necessary for inspection; then reinstall for storage.

G. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

H. Handling: Use sling to handle valves and fire hydrants whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels or stems as lifting or rigging points.

I. Deliver piping with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

J. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

K. Protect flanges, fittings, and specialties from moisture and dirt.

1.8 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Verify that water-service piping may be installed to comply with original design and referenced standards.

C. Site Information: Reports on subsurface condition investigations made during design of Project are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy or continuity of conditions between soil borings. Owner assumes no responsibility for interpretations or conclusions drawn from this information.

1.9 SEQUENCING AND SCHEDULING

A. Coordinate connection to water main with utility company.

B. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Drilling-Machine, Sleeves, and Corporation Stops:

   a. Ford Meter Box Co., Inc.
   b. Grinnell Corp.; Mueller Co.; Water Products Div.
   c. Lee Brass Co.

3. Tapping Sleeves and Valves:

   a. American Cast Iron Pipe Co.; Waterous Co.
   b. East Jordan Iron Works, Inc.
   c. Grinnell Corp.; Mueller Co.; Water Products Div.
   d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa)
   e. McWane, Inc.; Kennedy Valve Div.
   f. United States Pipe & Foundry Co.

4. Gate Valves:

   a. American AVK Co.
   b. American Cast Iron Pipe Co.; American Flow Control Div.
   c. American Cast Iron Pipe Co.; Waterous Co.
   d. East Jordan Iron Works, Inc.
   e. Grinnell Corp.; Grinnell Supply Sales Co.
   f. Grinnell Corp.; Mueller Co.; Water Products Div.
   g. Hammond Valve Corp.
   h. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa)
   i. McWane, Inc.; Kennedy Valve Div.

j. McWane, Inc.; Tyler Pipe; Utilities Div.
k. Milwaukee Valve Co., Inc.
l. Nibco, Inc.
m. Pratt: Henry Pratt Co.
n. Stockham Valves & Fittings, Inc.
o. United States Pipe & Foundry Co.

2.2 PIPES AND TUBES

A. Ductile-Iron, Push-on-Joint Pipe: AWWA C151, with cement-mortar lining and seal coat according to AWWA C104. Include rubber compression gasket according to AWWA C111.

B. Ductile-Iron, Mechanical-Joint Pipe: AWWA C151, with cement-mortar lining and seal coat according to AWWA C104. Include gland, rubber gasket, and bolts and nuts according to AWWA C111.

2.3 PIPE AND TUBE FITTINGS

A. Ductile-Iron, Push-on-Joint Fittings: AWWA C110, ductile-iron or cast-iron; or AWWA C153, ductile-iron, compact type. Include cement-mortar lining and seal coat according to AWWA C104 and rubber compression gaskets according to AWWA C111.

B. Ductile-Iron, Mechanical-Joint Fittings: AWWA C110, ductile-iron or cast-iron; or AWWA C153, ductile-iron, compact type. Include cement-mortar lining and seal coat according to AWWA C104 and glands, rubber gaskets, and bolts and nuts according to AWWA C111.

C. Ductile-Iron Fittings for PVC Pipe: AWWA C110, ductile-iron or cast-iron; or AWWA C153, ductile-iron, compact type; push-on- or mechanical-joint type. Include dimensions matching PVC pipe, cement-mortar lining and seal coat according to AWWA C104, and rubber compression gaskets according to AWWA C111.

2.4 JOINING MATERIALS

A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.

B. Ductile-Iron Piping: The following materials apply:

1. Push-on Joints: AWWA C111 rubber gaskets and lubricant.
2. Mechanical Joints: AWWA C111 ductile-iron or gray-iron glands, high-strength steel bolts and nuts, and rubber gaskets.

2.5 VALVES

A. Provide valve in accordance with local municipality Fire Department requirements.

B. Nonrising-Stem, Resilient-Seated Gate Valves, 3-Inch NPS (DN80) and Larger: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut. Include 200-psig (1380-kPa) minimum working-pressure design, interior coating according to AWWA C550, and push-on- or mechanical-joint ends.

C. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves, 3-Inch NPS (DN80) and Larger: AWWA C509, ductile-iron body and bonnet; with bronze or ductile-iron gate, re-

silient seats, bronze stem, and stem nut. Include 250-psig (1725-kPa) minimum working-pressure design, interior coating according to AWWA C550, and push-on- or mechanical-joint ends.

D. Valve Boxes: Cast-iron box with top section and cover with lettering "WATER," bottom section with base of size to fit over valve and barrel approximately 5 inches (125 mm) in diameter, and adjustable cast-iron extension of length required for depth of bury of valve.

1. Provide steel tee-handle operating wrench with each valve box. Include tee handle with one pointed end, stem of length to operate valve, and socket-fitting valve-operating nut.

E. Tapping Sleeve and Tapping Valve: Complete assembly, including tapping sleeve, tapping valve, and bolts and nuts. Use sleeve and valve compatible with tapping machine.

1. Tapping Sleeve: Cast- or ductile-iron, 2-piece bolted sleeve with flanged outlet for new branch connection. Sleeve may have mechanical-joint ends with rubber gaskets or sealing rings in sleeve body. Include sleeve matching size and type of pipe material being tapped and of outlet flange required for branch connection.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 31 Section "Earthwork" for excavation, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications:

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.

C. Do not use flanges or keyed couplings for underground piping.

D. Fire-Protection Water-Service Piping: Use the following:

E. 4- to 8-Inch NPS (DN100 to DN200): Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.

F. 4- to 8-Inch NPS (DN100 to DN200): Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

3.3 VALVE APPLICATIONS

A. Where specific valve types are not indicated, the following requirements apply:

B. Underground Valves, 3-Inch NPS (DN80) and Larger: AWWA, gate valves, nonrising stem, with valve box.

3.4 JOINT CONSTRUCTION

A. Ductile-Iron Piping, Gasketed Joints for Fire-Service Piping: According to UL 194 and AWWA C600.

3.5 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

B. Install components with pressure rating equal to or greater than system operating pressure.

C. Install piping free of sags and bends.

D. Install fittings for changes in direction and branch connections.

3.6 PIPING INSTALLATION

A. Water-Main Connection: Tap water main with size and in location as indicated according to requirements of water utility.

B. Comply with NFPA 24 for fire-protection water-service piping materials and installation.

C. Install ductile-iron piping according to AWWA C600.

D. Install piping under streets and other obstructions that cannot be disturbed, by tunneling, jacking, or combination of both.

3.7 ANCHORAGE INSTALLATION

A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

B. Fire-Service Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

A. General Application: Use mechanical-joint-end valves for 3-inch NPS (DN80) and larger underground installation. Use threaded- and flanged-end valves for installation in pits. Use nonrising-stem UL/FM gate valves for installation with indicator posts. Use bronze corporation stops and valves, with ends compatible with piping, for 2-inch NPS (DN50) and smaller installation.

B. AWWA-Type Gate Valves: Comply with AWWA C600. Install underground valves with stem pointing up and with cast-iron valve box.

3.9 IDENTIFICATION INSTALLATION

A. Install continuous plastic underground warning tape during back-filling of trench for underground water-service piping. Locate 6 to 8 inches (150 to 200 mm) below finished grade, directly over piping.

3.10 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than 1-1/2 times working pressure for 2 hours.

C. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within above limits.

END SECTION 33 10 00

SECTION 33 30 00 - SANITARY SEWERAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes sanitary sewerage outside the building.

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for concrete structures.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene-monomer rubber.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

B. Force-Main Pressure Ratings: At least equal to system operating pressure, but not less than 150 psig (1035 kPa).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.6 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Do not proceed with utility interruptions without Architect's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. PVC Backwater Valves and Cleanouts:

a. Canplas, Inc.
b. IPS Corp.
c. NDS, Inc.
d. Plastic Oddities, Inc.
e. Sioux Chief Manufacturing Co., Inc.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 PIPES AND FITTINGS

A. PVC Sewer Pipe and Fittings: According to the following:

1. PVC Sewer Pipe and Fittings, NPS 15 (DN375) and Smaller: ASTM D 3034, SDR 35, for solvent-cemented or gasketed joints.

a. Gaskets: ASTM F 477, elastomeric seals.

2.4 SPECIAL PIPE COUPLINGS AND FITTINGS

A. Sleeve-Type Pipe Couplings: ASTM C 1173, rubber or elastomeric sleeve and band assembly fabricated to mate with OD of pipes to be joined, for nonpressure joints.

1. Sleeve Material for Plastic Pipe: ASTM F 477, elastomeric seal.
2. Sleeve Material for Dissimilar Pipe: Compatible with pipe materials being joined.
3. Bands: Stainless steel, at least one at each pipe insert.

2.5 CLEANOUTS

A. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

3.2 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earthwork." Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.

1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 PIPING APPLICATIONS

A. General: Include watertight joints.

B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.

C. Gravity-Flow Piping: Use the following:

1. NPS 4 and NPS 6 (DN100 and DN150): Cellular-core PVC pipe, PVC sewer pipe fittings, and solvent-cemented joints.
2. NPS 4 and NPS 6 (DN100 and DN150): PVC sewer pipe and fittings, solvent-cemented joints, or gaskets and gasketed joints.
3. NPS 8 and NPS 10 (DN200 and DN250): PVC sewer pipe and fittings, solvent-cemented joints, or gaskets and gasketed joints.

3.4 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

1. Use the following pipe couplings for nonpressure applications:

a. Sleeve type to join piping, of same size, or with small difference in OD.
b. Increaser/reducer-pattern, sleeve type to join piping of different sizes.
c. Bushing type to join piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.5 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Extend sanitary sewerage piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping five (5) feet outside building wall.

F. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

3.6 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. PVC Sewer Pipe and Fittings: As follows:

1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
2. Join profile sewer pipe fittings with gaskets according to ASTM D 2321 and manufacturer's written instructions.
3. Install according to ASTM D 2321.

B. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

C. Install with top surfaces of components, except piping, flush with finished surface.

3.7 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set with tops 1 inch (25 mm) above surrounding grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.8 TAP CONNECTION

A. Make connection to existing public sanitary sewer piping in accordance with City of Appleton Utility requirements.

B. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.9 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. Place plug in end of incomplete piping at end of day and when work stops.
2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.

2. Defects requiring correction include the following:

   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

4. Reinspect and repeat procedure until results are satisfactory.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate reports for each test.
5. If authorities having jurisdiction do not have published procedures, perform tests as follows:

   a. Sanitary Sewerage: Perform hydrostatic test.

      1) Allowable leakage is maximum of 50 gal. per inch of nominal pipe size per mile (4.6 L per millimeter of nominal pipe size per kilometer) of pipe, during 24-hour period.
      2) Close openings in system and fill with water.
      3) Purge air and refill with water.
      4) Disconnect water supply.
      5) Test and inspect joints for leaks.
      6) Option: Test ductile-iron piping according to AWWA C600, Section "Hydrostatic Testing." Use test pressure of at least 10 psig (69 kPa).

6. Manholes (where applicable): Perform hydraulic test according to ASTM C 969 (ASTM C 969M).
7. Leaks and loss in test pressure constitute defects that must be repaired.
8. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 33 30 00

SECTION 33 46 13 - FOUNDATION DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. This section includes subdrainage systems for the following:

1. Foundations.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Perform foundation drainage work in compliance with applicable requirements of governing authorities having jurisdiction.

1.4 SUBMITTALS:

A. Product Data: Submit product data for piping and accessories.

B. Certification: Submit Certification signed by Contractor and subdrainage system installer that installed materials conform to specified requirements and system was successfully checked and tested prior to covering with filtering and drainage fill.

PART 2 - PRODUCTS

2.1 DRAINAGE PIPE AND FITTINGS:

A. Perforated, PE Pipe and Fittings: ASTM F 405, corrugated, for coupled joints.

1. Couplings: Manufacturer's standard, band type.

2.2 SPECIAL PIPE COUPLINGS

A. Description: ASTM C 1173. Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined.

2.3 CLEANOUTS

A. Cast-Iron Pipe: ASME A112.36.2M; with round-flanged cast-iron housing; and secured, scoriated, Medium-Duty Loading class, cast-iron cover. Include cast-iron ferrule and countersunk, brass cleanout plug.

B. PVC Pipe: ASTM D 3034, PVC cleanout threaded plug and threaded pipe hub.

C. Joint Screening: Provide joint screening for each open-joint portion of drain lines, of the following:

1. Synthetic drainage fabric.

2.4 SOIL MATERIALS:

A. Impervious Fill: Clay gravel and sand mixture capable of compacting to a dense composite.

B. Drainage Fill: Evenly graded mixture of natural or crushed gravel, crushed stone, ASTM D 448, coarse aggregate, Size 57, with 100 percent passing a 1-1/2 inch sieve and not more than 5 percent passing a No. 8 sieve.

C. Filtering Material: Evenly graded mixture of natural or crushed gravel, crushed stone and natural sand with 100 percent passing a 1-1/2 inch sieve and 0-5 percent passing a No. 50 sieve.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Impervious Fill at Footings: After concrete footings have been cured and forms removed, place impervious fill material on subgrade adjacent to bottom of footing. Place and compact impervious fill to dimensions indicated or, if not indicated, not less than 6 inches deep and 12 inches wide.

B. Filtering Material: Place supporting layer of filtering material over compacted subgrade where drainage pipe is to be laid to depth indicated or, if not indicated, to a compacted depth of not less than 4 inches. After testing drain lines, place additional filtering material to a 4 inch depth around sides and top of drains.

C. Laying Drain Pipe: Lay drain pipe solidly bedded in filtering material. Provide full bearing for each pipe section throughout its length to true grades and alignment and continuous slope in direction of flow.

1. Lay perforated pipe with perforations down and joints tightly closed in accordance with pipe manufacturers recommendations. Provide collars and couplings as required.
2. Provide recesses in excavation bottom to receive bells for drain pipe having bell and spigot ends. Lay pipe with bells facing up slope with spigot end entered fully into adjacent bell. Seal joint in accordance with local practices having jurisdiction.

D. Testing Drain Lines: Test or check lines before backfilling to assure free flow. Remove obstructions, replace damaged components and retest system until satisfactory.

E. Drainage Fill:

1. Place drainage fill over drain lines after satisfactory testing and covering of drain lines with filtering material. Completely cover drain lines to a width of at least 6 inches on each side and above top of pipe to within 12 inches of finish grade. Place fill material in layers not exceeding 3 inches in loose depth and compact each layer placed.
2. Overlay drainage fill material with one layer of 15 lb. asphalt- or tar-saturated felt or synthetic drainage fabric overlapping edges at least 4 inches.

F. Fill to Grade: Where indicated apply impervious fill material over compacted drainage fill

F. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

3.6 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. PVC Sewer Pipe and Fittings: As follows:

1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
2. Join profile sewer pipe fittings with gaskets according to ASTM D 2321 and manufacturer's written instructions.
3. Install according to ASTM D 2321.

B. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

C. Install with top surfaces of components, except piping, flush with finished surface.

3.7 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set with tops 1 inch (25 mm) above surrounding grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.8 TAP CONNECTION

A. Make connection to existing public sanitary sewer piping in accordance with City of Appleton Utility requirements.

B. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.9 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. Place plug in end of incomplete piping at end of day and when work stops.
2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.

2. Defects requiring correction include the following:

   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

4. Reinspect and repeat procedure until results are satisfactory.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate reports for each test.
5. If authorities having jurisdiction do not have published procedures, perform tests as follows:

   a. Sanitary Sewerage: Perform hydrostatic test.

      1) Allowable leakage is maximum of 50 gal. per inch of nominal pipe size per mile (4.6 L per millimeter of nominal pipe size per kilometer) of pipe, during 24-hour period.
      2) Close openings in system and fill with water.
      3) Purge air and refill with water.
      4) Disconnect water supply.
      5) Test and inspect joints for leaks.
      6) Option: Test ductile-iron piping according to AWWA C600, Section "Hydrostatic Testing." Use test pressure of at least 10 psig (69 kPa).

6. Manholes (where applicable): Perform hydraulic test according to ASTM C 969 (ASTM C 969M).
7. Leaks and loss in test pressure constitute defects that must be repaired.
8. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 33 30 00

SECTION 33 46 13 - FOUNDATION DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. This section includes subdrainage systems for the following:

1. Foundations.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Perform foundation drainage work in compliance with applicable requirements of governing authorities having jurisdiction.

1.4 SUBMITTALS:

A. Product Data: Submit product data for piping and accessories.

B. Certification: Submit Certification signed by Contractor and subdrainage system installer that installed materials conform to specified requirements and system was successfully checked and tested prior to covering with filtering and drainage fill.

PART 2 - PRODUCTS

2.1 DRAINAGE PIPE AND FITTINGS:

A. Perforated, PE Pipe and Fittings: ASTM F 405, corrugated, for coupled joints.

1. Couplings: Manufacturer's standard, band type.

2.2 SPECIAL PIPE COUPLINGS

A. Description: ASTM C 1173. Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined.

2.3 CLEANOUTS

A. Cast-Iron Pipe: ASME A112.36.2M; with round-flanged cast-iron housing; and secured, scoriated, Medium-Duty Loading class, cast-iron cover. Include cast-iron ferrule and countersunk, brass cleanout plug.

B. PVC Pipe: ASTM D 3034, PVC cleanout threaded plug and threaded pipe hub.

C. Joint Screening: Provide joint screening for each open-joint portion of drain lines, of the following:

1. Synthetic drainage fabric.

2.4 SOIL MATERIALS:

A. Impervious Fill: Clay gravel and sand mixture capable of compacting to a dense composite.

B. Drainage Fill: Evenly graded mixture of natural or crushed gravel, crushed stone, ASTM D 448, coarse aggregate, Size 57, with 100 percent passing a 1-1/2 inch sieve and not more than 5 percent passing a No. 8 sieve.

C. Filtering Material: Evenly graded mixture of natural or crushed gravel, crushed stone and natural sand with 100 percent passing a 1-1/2 inch sieve and 0-5 percent passing a No. 50 sieve.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Impervious Fill at Footings: After concrete footings have been cured and forms removed, place impervious fill material on subgrade adjacent to bottom of footing. Place and compact impervious fill to dimensions indicated or, if not indicated, not less than 6 inches deep and 12 inches wide.

B. Filtering Material: Place supporting layer of filtering material over compacted subgrade where drainage pipe is to be laid to depth indicated or, if not indicated, to a compacted depth of not less than 4 inches. After testing drain lines, place additional filtering material to a 4 inch depth around sides and top of drains.

C. Laying Drain Pipe: Lay drain pipe solidly bedded in filtering material. Provide full bearing for each pipe section throughout its length to true grades and alignment and continuous slope in direction of flow.

1. Lay perforated pipe with perforations down and joints tightly closed in accordance with pipe manufacturers recommendations. Provide collars and couplings as required.
2. Provide recesses in excavation bottom to receive bells for drain pipe having bell and spigot ends. Lay pipe with bells facing up slope with spigot end entered fully into adjacent bell. Seal joint in accordance with local practices having jurisdiction.

D. Testing Drain Lines: Test or check lines before backfilling to assure free flow. Remove obstructions, replace damaged components and retest system until satisfactory.

E. Drainage Fill:

1. Place drainage fill over drain lines after satisfactory testing and covering of drain lines with filtering material. Completely cover drain lines to a width of at least 6 inches on each side and above top of pipe to within 12 inches of finish grade. Place fill material in layers not exceeding 3 inches in loose depth and compact each layer placed.
2. Overlay drainage fill material with one layer of 15 lb. asphalt- or tar-saturated felt or synthetic drainage fabric overlapping edges at least 4 inches.

F. Fill to Grade: Where indicated apply impervious fill material over compacted drainage fill

at footing drains, placing material in layers not exceeding 6 inches in loose depth and thoroughly compacting each layer. Carry impervious fill to indicated finish elevations and slope away from building perimeter.

END SECTION 33 46 13

SECTION E: PROPOSAL

FIRE STATION NO. 2 REMODEL
CONTRACT NO. 6586

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 - 2012 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.
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. Accompanying this Proposal is ☐ Bid Bond or ☐ Certified Check in the amount of _____ Dollars ($_____)or a Certificate of Biennial Bid Bond as required by the Advertisement for Bids.
   (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.

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			
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)

FIRE STATION NO. 2 REMODEL
CONTRACT NO. 6586

Best Value Contracting

1. The Contractor shall indicate the non-apprenticeable trades used on this contract.

_____

_____

_____

_____

_____

_____

_____

2. Some Contractors are exempt due to the size of the work force. Apprenticeable trades are those trades considered apprenticeable by the State of Wisconsin.

☐ Check Here if the Contractor has a total skilled work force of four or less individuals in all apprenticeable trades combined. This contractor is exempt from Best Value Contracting.

3. The Contractor shall indicate on page E-4 which apprenticeable trades are to be used on this Contract and shall indicate by checking the appropriate box for the trades used, how the contractor will comply with Madison General Ordinance 33.07(7).

Legend

Number of Journeyworkers	The Contractor shall indicated for trades to be used on this Contract only, the number of journeyworkers that the Contractor has employed company wide.
W-ATT	The Contractor is an active trade trainer in the State of Wisconsin for the trade indicated.
US-ATT	The Contractor is an active trade trainer in an apprenticeship program approved by the U.S. Department of Labor or another state apprenticeship agency in the trade indicated.
SB-ATT	The Contractor shall become an active trade trainer prior to beginning work on the Contract in the trade indicated.

☐ The Contractor has reviewed the list on page E-4 and shall not use any apprenticeable trades on this project.

☐ The Contractor has reviewed this list on E-4 and has checked the appropriate box by each apprenticeable trade to be used on the project.

FIRE STATION NO. 2 REMODEL
CONTRACT NO. 6586

Apprenticeable Trades

Check the box in the column "Trade Used on This Project" for each apprenticeable trades used on this project. For those trades used on the project indicated the number of journeyworkers that are employed company wide and check a box to the right of the trade as to how the Contractor will comply MGO 33.07(7). Refer to the legend on page E-3 for the meaning associated with each heading. The Contractor must check one of the boxes on the right for each apprenticeable trade used and checked on the left.

Trade Used on Contract	Apprenticeable Trades	Number of Journeyworkers	W-ATT	US-ATT	SB-ATT
☐	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 & Waterproofer		☐	☐	☐
☐	Sheet Metal Worker		☐	☐	☐
☐	Sprinklerfitter		☐	☐	☐
☐	Steamfitter		☐	☐	☐
☐	Steamfitter (Refrigeration)		☐	☐	☐
☐	Steamfitter (Service)		☐	☐	☐
☐	Taper & Finisher		☐	☐	☐
☐	Telecommunications (Voice, Data & Video) Installer-Technician		☐	☐	☐
☐	Tile Setter		☐	☐	☐

PROPOSAL

NAME OF BIDDER

FIRE STATION NO. 2 REMODEL
CONTRACT NO. 6586
ACCOUNT NUMBER: CB72-58430-810640

TYPE OF WORK	**TOTAL BID**
BASE BID LUMP SUM	

ALTERNATE 1

ADD THE CONCRETE PATIO AND PERGOLA ON THE EXTERIOR OF THE BUILDING	

ALTERNATE 2

ADD RESINOUS FLOORING IN ROOMS 101, 102, 103 104 & 105	

NOTE: The bidder must completely fill in the base bid and the alternate(s) in ink. After the bid submission and prior to bid opening the City will establish a Construction Budget Dollar Value.

1. If any responsible bidder submits a base bid plus alternate one (1) and alternate two (2) that is below the Construction Budget Dollar Value, the City will award the contract based on the base bid plus alternate one (1) and alternate two (2).

2. If paragraph #1 above does not apply, and if any responsible bidder submits a base bid plus alternate one (1) that is below the Construction Budget Dollar Value, the City will award the contract based on the base bid plus alternate one (1).

3. If paragraphs #1 and #2 above do not apply, and if no responsible bidder submits a base bid plus alternate one (1) that is below the Construction Dollar Value, the City will award the contract based on the base bid only.

The City shall have the right to proceed or not proceed with alternates regardless of how the bid was awarded. The City shall have the right to reject all bids regardless of the value of the bids submitted.

SECTION F: 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:

FIRE STATION NO. 2 REMODEL
CONTRACT NO. 6586

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 may 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 City of Madison, Wisconsin

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 G: AGREEMENT

THIS AGREEMENT made this _____ day of _____ in the year Two Thousand and Twelve 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:

FIRE STATION NO. 2 REMODEL
CONTRACT NO. 6586

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 as hereinafter provided.

"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 preapprentices, 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 Subjourneypersons. Apprentices and subjourneypersons 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 therefor; 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 therefor; 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, 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 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 or national original 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 Contractors state that all qualified or qualifiable applicants will be employed without regard to race, religion, color, age, marital status, disability, sex 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 Director of Affirmative Action.

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.

FIRE STATION NO. 2 REMODEL
CONTRACT NO. 6586

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 H: 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:

FIRE STATION NO. 2 REMODEL
CONTRACT NO. 6586

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

_____ By _____
City Attorney 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

MINIMUM WAGE SCALE

FOR

PUBLIC WORKS IMPROVEMENTS

APPROVED BY: BOARD OF PUBLIC WORKS

MADISON, WISCONSIN

February 7, 2012

The attached "Prevailing Wage Rate Determination: (Pages 1 through 30), issued February 7, 2012, is hereby approved as the Minimum Wage Scale of the City of Madison.

State of Wisconsin
Department of Workforce Development
Equal Rights Division

DEPARTMENTAL ORDER

ISSUE DATE: 1/13/2012

PROJECT:

ALL PUBLIC WORKS PROJECTS UNDER SEC 66.0903, STATS.-CITY OF MADISON
MADISON CITY, DANE COUNTY, WI
Determination No. 201200105

PROJECT OWNER:	REQUESTER:
ROBERT F. PHILLIPS, CITY ENGINEER CITY OF MADISON-ENGINEERING 210 MARTIN L KING JR BLVD, RM 115 MADISON, WI 53703	ROBERT F. PHILLIPS, CITY ENGINEER CITY OF MADISON-ENGINEERING 210 MARTIN L KING JR BLVD, RM 115 MADISON, WI 53703

ADDITIONAL CONTACT:

NORMAN DAVIS, CONTRACT COMPLIANCE
CITY OF MADISON-DEPT OF CIVIL RTS-AA DIV
210 MARTIN L KING JR BLVD, RM 523
MADISON, WI 537033342

The department received an application for prevailing wage rate determination for the above-captioned project. The department conducted a survey to determine the prevailing wage rate for the trade(s) or occupation(s) needed to complete the project. The survey's findings appear in the attached project determination.

If you believe that the wage rate for any trade or occupation does not accurately reflect the prevailing wage rate in the city, village or town where the project is located, you may ask the department to conduct an administrative review of such wage rate. You must submit this request in writing within 30 days from the date indicated above. Additionally, your request must include wage rate information from at least three similar projects in the city, village or town where the proposed project is located and on which some work has been performed by the contested trade(s) during the current survey period and was previously considered by the department in issuing the attached determination. See DWD 290.10 of the Wisconsin Administrative Code and either s. 66.0903(3)(br), s. 66.0904(4)(e), or s. 103.49(3)(c), Stats., for a complete explanation of the administrative review process.

Enclosures

It is hereby ordered that the prevailing wage rates set forth in the attached project determination shall only be applicable to the above referenced project. This order is a **FINAL ORDER** of the department unless a timely request for an administrative review is filed with the department.

ISSUED BY:

Equal Rights Division
Labor Standards Bureau
Construction Wage Standards Section
PO Box 8928 Madison, WI 53708-8928
(608)266-6861

Web Site: http://dwd.wisconsin.gov/er/

PREVAILING WAGE RATE DETERMINATION
Issued by the State of Wisconsin
Department of Workforce Development
Pursuant to s. 66.0903, Wis. Stats.
Issued On: 1/13/2012

DETERMINATION NUMBER:	201200105
EXPIRATION DATE:	Prime Contracts MUST Be Awarded or Negotiated On Or Before 12/31/2012. 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

CLASSIFICATION:	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: dwd.wisconsin.gov/er/prevailing_wage_rate/Dictionary/dictionary_main.htm.
OVERTIME:	Time and one-half must be paid for all hours worked: - over 10 hours per day on prevailing wage projects - over 40 hours per calendar week - Saturday and Sunday - 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; - The day before if January 1, July 4 or December 25 falls on a Saturday; - The day following if January 1, July 4 or December 25 falls on a Sunday. 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. A DOT Premium (discussed below) may supersede this time and one-half requirement.
FUTURE INCREASE:	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.
PREMIUM PAY:	If indicated for a specific trade or occupation, the full amount of such pay MUST be added to the "HOURLY BASIC RATE OF PAY" indicated for such trade or occupation, whevenever such pay is applicable.
DOT PREMIUM:	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.
APPRENTICES:	Pay apprentices a percentage of the applicable journeyperson'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.
SUBJOURNEY:	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.

BUILDING OR HEAVY CONSTRUCTION

Includes sheltered enclosures with walk-in access for the purpose of housing persons, employees, machinery, equipment or supplies and non-sheltered work such as canals, dams, dikes, reservoirs, storage tanks, etc. A sheltered enclosure need not be "habitable" in order to be considered a building. The installation of machinery and/or equipment, both above and below grade level, does not change a project's character as a building. On-site grading, utility work and landscaping are included within this definition. Residential buildings of four (4) stories or less, agricultural buildings, parking lots and driveways are NOT included within this definition.

SKILLED TRADES

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
101	Acoustic Ceiling Tile Installer	29.06	15.16	44.22
102	Boilermaker	31.09	23.75	54.84
103	Bricklayer, Blocklayer or Stonemason Future Increase(s): Add $.50/hr on 6/1/2012; Add $ .80 on 6/1/2013 Premium Increase(s): 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.	32.26	16.60	48.86
104	Cabinet Installer	29.06	15.16	44.22
105	Carpenter	29.06	15.16	44.22
106	Carpet Layer or Soft Floor Coverer	29.06	15.16	44.22
107	Cement Finisher	32.03	15.13	47.16
108	Drywall Taper or Finisher	26.10	13.65	39.75
109	Electrician Future Increase(s): Add $.50/hr on 6/1/2012. Premium Increase(s): 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.	32.55	18.68	51.23
110	Elevator Constructor	43.79	25.48	69.27
111	Fence Erector	25.50	0.26	25.76
112	Fire Sprinkler Fitter	36.39	16.75	53.14
113	Glazier	36.23	11.22	47.45
114	Heat or Frost Insulator	33.28	22.51	55.79
115	Insulator (Batt or Blown)	23.62	11.55	35.17
116	Ironworker	30.90	19.11	50.01
117	Lather	29.06	15.16	44.22

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
118	Line Constructor (Electrical)	35.97	18.08	54.05
119	Marble Finisher	31.16	16.27	47.43
120	Marble Mason	32.66	16.20	48.86
121	Metal Building Erector	22.00	4.11	26.11
122	Millwright	30.66	15.21	45.87
123	Overhead Door Installer	18.00	4.86	22.86
124	Painter	25.65	14.11	39.76
125	Pavement Marking Operator	26.00	0.00	26.00
126	Piledriver	29.56	15.16	44.72
127	Pipeline Fuser or Welder (Gas or Utility)	29.54	18.84	48.38
129	Plasterer	29.03	15.16	44.19
130	Plumber	36.20	15.02	51.22
132	Refrigeration Mechanic Future Increase(s): Add $.85/hr on 12/1/11; Add $.90/hr on 6/1/12; Add $.85/hr on 12/1/12.	40.35	16.21	56.56
133	Roofer or Waterproofer	28.06	0.00	28.06
134	Sheet Metal Worker	34.23	20.19	54.42
135	Steamfitter Future Increase(s): Add $.85/hr on 12/1/11; Add $.90/hr on 6/1/12; Add $.85/hr on 12/1/12.	40.35	16.21	56.56
137	Teledata Technician or Installer	21.26	6.99	28.25
138	Temperature Control Installer	32.55	18.68	51.23
139	Terrazzo Finisher	18.00	5.35	23.35
140	Terrazzo Mechanic	31.16	16.27	47.43
141	Tile Finisher Future Increase(s): Add $.50/hr on 6/1/2012; Add $ .80/hr on 6/1/2013.	23.77	16.00	39.77
142	Tile Setter Future Increase(s): Add $.50/hr on 6/1/2012; Add $ .80/hr on 6/1/2013.	29.71	16.00	45.71
143	Tuckpointer, Caulker or Cleaner	22.00	9.75	31.75
144	Underwater Diver (Except on Great Lakes)	36.20	18.81	55.01
146	Well Driller or Pump Installer	25.32	15.30	40.62

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
147	Siding Installer	16.74	2.58	19.32
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	32.37	16.48	48.85
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	28.78	15.16	43.94
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	17.80	9.00	26.80
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	23.38	12.48	35.86
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.30	10.97	32.27

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	18.00	6.98	24.98
203	Three or More Axle Future Increase(s): Add $1.57/hr on 6/1/2012.	18.00	13.83	31.83
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add $1/hr on 6/3/2012; Add $1/hr on 6/2/2013.	31.89	17.98	49.87
205	Pavement Marking Vehicle	19.25	10.84	30.09
207	Truck Mechanic	18.00	13.68	31.68

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer Future Increase(s): Add $.50/hr. on 06/04/2012; Add $.75/hr. on 06/03/2013 Premium Increase(s): Add $1.00/hr for certified welder; Add $.25/hr for mason tender	24.14	13.45	37.59
302	Asbestos Abatement Worker	23.96	12.88	36.84
303	Landscaper	17.00	6.36	23.36
310	Gas or Utility Pipeline Laborer (Other Than Sewer and Water)	20.39	12.20	32.59
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	16.51	0.00	16.51
314	Railroad Track Laborer	14.00	4.77	18.77

HEAVY EQUIPMENT OPERATORS
SITE PREPARATION, UTILITY OR LANDSCAPING WORK ONLY

Fringe Benefits Must Be Paid On All Hours Worked

CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
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 Mfgr's Rated Capacity of 130,000 Lbs. or Over; Backhoe (Track Type) Having a Mfgr'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). Future Increase(s): Add $1/hr on 6/3/2012; Add $1/hr on 6/2/2013.	32.42	17.98	50.40
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).	31.89	14.44	46.33
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. Future Increase(s): Add $1/hr on 6/3/2012; Add $1/hr on 6/2/2013.	31.89	17.98	49.87
504	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	36.20	18.81	55.01
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. Premium Increase(s): Add $.50/hr for friction crane, lattice boom or crane certification (CCO).	37.45	19.45	56.90

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
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.	26.80	18.52	45.32
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.	27.75	19.15	46.90

HEAVY EQUIPMENT OPERATORS
EXCLUDING SITE PREPARATION, UTILITY, PAVING LANDSCAPING WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
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. Future Increase(s): Add $1/hr on 6/3/2012; Add $1/hr on 6/2/2013. Premium Increase(s): Add $.50/hr at 200 ton: Add $1.00/hr. at 300 ton; Add $1.50/hr at 400 ton; Add $2.00/hr at 500 ton.	34.62	17.98	52.60
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). Future Increase(s): Add $1/hr on 6/3/2012; Add $1/hr on 6/2/2013. Premium Increase(s): Add $.25/hr for cranes with lifting capacity of 45 ton or over.	33.62	17.98	51.60
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). Future Increase(s): Add $1/hr on 6/3/2012; Add $1/hr on 6/2/2013.	32.42	17.98	50.40

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
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). Future Increase(s): Add $1/hr on 6/3/2012; Add $1/hr on 6/2/2013.	31.89	17.98	49.87
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; 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; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames.	35.59	19.10	54.69
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; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add $1/hr on 6/3/2012; Add $1/hr on 6/2/2013.	29.19	17.98	47.17
514	Gas or Utility Pipeline, Except Sewer & Water (Primary Equipment). Future Increase(s): Add $2/hr. on 1/1/2013.	34.89	19.68	54.57
515	Gas or Utility Pipeline, Except Sewer & Water (Secondary Equipment).	30.32	17.40	47.72
516	Fiber Optic Cable Equipment	22.00	7.27	29.27

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

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
103	Bricklayer, Blocklayer or Stonemason	32.66	16.20	48.86
105	Carpenter Premium Increase(s): 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.	33.43	19.31	52.74
107	Cement Finisher Future Increase(s): Add $1.86 on 6/1/12; Add $1.87 on 6/1/13; Add $1.87 on 6/1/14; Add $1.87 on 6/1/15; Add $1.75 on 6/1/16. Premium Increase(s): 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.	30.68	15.68	46.36
109	Electrician Future Increase(s): Add $1.40/hr on 6/1/2012. Add $1.60/hr on 6/1/2013. Premium Increase(s): 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.	31.54	20.95	52.49
111	Fence Erector	25.50	0.26	25.76
116	Ironworker Premium Increase(s): 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.	31.31	22.22	53.53
118	Line Constructor (Electrical)	35.97	18.08	54.05
125	Pavement Marking Operator	26.00	0.00	26.00
126	Piledriver	29.56	15.16	44.72
130	Plumber	36.20	15.02	51.22
135	Steamfitter	39.90	15.76	55.66
137	Teledata Technician or Installer	21.26	6.99	28.25

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
143	Tuckpointer, Caulker or Cleaner	22.00	9.75	31.75
144	Underwater Diver (Except on Great Lakes)	36.20	18.81	55.01
146	Well Driller or Pump Installer	24.22	14.80	39.02
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	32.37	16.48	48.85
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	28.78	15.16	43.94
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	17.80	9.00	26.80
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	23.38	12.48	35.86
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.30	10.97	32.27

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	23.00	8.64	31.64
203	Three or More Axle	21.17	9.51	30.68
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add $1.75/hr on 6/1/2012; Add $1.85/hr on 6/1/2013. Premium Increase(s): 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.	22.50	16.19	38.69
205	Pavement Marking Vehicle	19.25	10.84	30.09
207	Truck Mechanic	21.17	9.51	30.68

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer Future Increase(s): Add $.70/hr. on 06/04/2012; Add $.80/hr. on 06/03/2013 Premium Increase(s): Add $.20 for blaster, bracer, manhole builder, caulker, bottomman and power tool; Add $.55 for pipelayer; Add $1.00 for tunnel work 0-15 lbs. compressed air; Add $2.00 for over 15-30 lbs. compressed air; Add $3.00 for over 30 lbs. compressed air.	25.28	13.44	38.72

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
303	Landscaper	17.00	6.36	23.36
304	Flagperson or Traffic Control Person	12.00	17.89	29.89
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	16.51	0.00	16.51
314	Railroad Track Laborer	14.00	4.77	18.77

HEAVY EQUIPMENT OPERATORS
SEWER, WATER OR TUNNEL WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
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. Future Increase(s): Add $1/hr on 6/3/2012; Add $1/hr on 6/2/2013. Premium Increase(s): Add $.25/hr for cranes with lifting capacity of 45 ton or over.	33.62	17.98	51.60
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). Future Increase(s): Add $1/hr on 6/3/2012; Add $1/hr on 6/2/2013.	32.42	17.98	50.40

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
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). Future Increase(s): Add $1/hr on 6/3/2012; Add $1/hr on 6/2/2013.	31.89	17.98	49.87
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.	30.89	17.16	48.05
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. Future Increase(s): Add $1/hr on 6/3/2012; Add $1/hr on 6/2/2013.	29.19	17.98	47.17
526	Boiler (Temporary Heat); Forklift; Greaser; Oiler.	29.19	17.96	47.15
527	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	36.20	18.81	55.01
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.	36.20	18.81	55.01

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
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.	26.80	18.52	45.32
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.	26.80	18.52	45.32

AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION

Includes all airport projects (excluding buildings) and all projects awarded by the Wisconsin Department of Transportation (excluding buildings).

SKILLED TRADES

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
103	Bricklayer, Blocklayer or Stonemason	32.66	15.92	48.58
105	Carpenter	30.23	15.16	45.39
107	Cement Finisher Future Increase(s): Add $1.86 on 6/1/12; Add $1.87 on 6/1/13; Add $1.87 on 6/1/14; Add $1.87 on 6/1/15; Add $1.75 on 6/1/16. Premium Increase(s): 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.	30.68	15.68	46.36
109	Electrician	37.25	14.68	51.93
111	Fence Erector	35.62	0.00	35.62
116	Ironworker	30.90	19.11	50.01
118	Line Constructor (Electrical)	35.97	18.08	54.05
124	Painter	28.00	11.15	39.15
125	Pavement Marking Operator	26.65	14.92	41.57
126	Piledriver	29.56	15.16	44.72
133	Roofer or Waterproofer	28.06	0.00	28.06
137	Teledata Technician or Installer	21.26	6.99	28.25
143	Tuckpointer, Caulker or Cleaner	22.00	9.75	31.75
144	Underwater Diver (Except on Great Lakes)	36.20	18.81	55.01
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	35.42	12.90	48.32
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	35.50	14.27	49.77
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.18	14.07	39.25
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	23.38	12.48	35.86

154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.30	10.97	32.27

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle Future Increase(s): Add $1.75/hr on 6/1/2012; Add $1.85/hr on 6/1/2013. Premium Increase(s): 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.	22.35	16.19	38.54
203	Three or More Axle Future Increase(s): Add $1.75/hr on 6/1/2012; Add $1.85/hr on 6/1/2013. Premium Increase(s): 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.	22.50	16.19	38.69
204	Articulated, Euclid, Dumptor, Off Road Material Hauler	24.91	15.63	40.54
205	Pavement Marking Vehicle	23.84	14.76	38.60
206	Shadow or Pilot Vehicle	24.76	15.35	40.11
207	Truck Mechanic	24.91	15.35	40.26

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer Future Increase(s): Add $1.60/hr on 6/1/2012: Add $1.70/hr on 6/1/2013; Add $1.60/hr on 6/1/2014. Premium Increase(s): Add $.10/hr for topman, air tool operator, vibrator or tamper operator (mechanical hand operated), chain saw operator and demolition burning torch laborer; Add $.15/hr for bituminous worker (raker and luteman), formsetter (curb, sidewalk and pavement) and strike off man; Add $.20/hr for blaster and powderman; Add $.25/hr for bottomman; Add $.35/hr for line and grade specialist; Add $.45/hr for pipelayer. / 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 $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	27.20	13.45	40.65
302	Asbestos Abatement Worker	23.96	12.88	36.84
303	Landscaper Future Increase(s): Add $1.60/hr on 6/1/12; Add $1.70/hr on 6/1/13; Add $1.60/hr on 6/1/14. Premium Increase(s): 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 $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	27.20	13.45	40.65
304	Flagperson or Traffic Control Person Future Increase(s): Add $1.60/hr on 6/1/2012; Add $1.70/hr on 6/1/2013; Add $1.60/hr on 6/1/2014. Premium Increase(s): 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 $1.25/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.	23.55	13.45	37.00

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	16.51	0.00	16.51
314	Railroad Track Laborer	14.00	4.77	18.77

HEAVY EQUIPMENT OPERATORS
AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
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). Future Increase(s): Add $2/hr on 6/1/12; Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): 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 $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	34.22	18.90	53.12
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. Future Increase(s): Add $2/hr on 6/1/12; Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): 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 $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	33.72	18.90	52.62

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
533	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & 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. & Under); Bituminous (Asphalt) Plant & 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 & 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; 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 & A-Frames. Future Increase(s): Add $2/hr on 6/1/12; Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): 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 $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	33.22	18.90	52.12

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
534	Belting, Burlap, Texturing Machine; 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 Sawer (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. Future Increase(s): Add $2/hr on 6/1/12; Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): 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 $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	32.96	18.90	51.86
535	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; 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. Future Increase(s): Add $2/hr on 6/1/12; Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): 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 $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	32.67	18.90	51.57
536	Fiber Optic Cable Equipment.	22.00	7.27	29.27
537	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	36.20	18.81	55.01

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
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.	36.20	18.81	55.01
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.	26.80	18.52	45.32
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.	26.80	18.52	45.32

LOCAL STREET OR MISCELLANEOUS PAVING CONSTRUCTION

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

SKILLED TRADES

Fringe Benefits Must Be Paid On All Hours Worked

CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
103	Bricklayer, Blocklayer or Stonemason	32.66	16.20	48.86
105	Carpenter	29.06	15.16	44.22
107	Cement Finisher Future Increase(s): Add $1.86 on 6/1/12; Add $1.87 on 6/1/13; Add $1.87 on 6/1/14; Add $1.87 on 6/1/15; Add $1.75 on 6/1/16. Premium Increase(s): 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.	30.68	15.68	46.36
109	Electrician Future Increase(s): Add $.50/hr. effective 06/04/2012. Premium Increase(s): 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.	28.74	17.86	46.60
111	Fence Erector	25.50	0.26	25.76
116	Ironworker	30.90	19.11	50.01
118	Line Constructor (Electrical)	35.97	18.08	54.05
124	Painter	25.65	14.11	39.76
125	Pavement Marking Operator	26.00	0.00	26.00
126	Piledriver	29.56	15.16	44.72
133	Roofer or Waterproofer	28.06	0.00	28.06
137	Teledata Technician or Installer	21.26	6.99	28.25
143	Tuckpointer, Caulker or Cleaner	22.00	9.75	31.75
144	Underwater Diver (Except on Great Lakes)	36.20	18.81	55.01
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	35.42	12.90	48.32

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY Premium Increase(s): 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.	29.64	14.64	44.28
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.18	13.07	38.25
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	23.38	12.48	35.86
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.30	10.97	32.27

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	15.00	0.00	15.00
203	Three or More Axle	19.50	4.97	24.47
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add $1/hr on 6/3/2012; Add $1/hr on 6/2/2013.	31.89	17.98	49.87
205	Pavement Marking Vehicle	19.25	10.84	30.09
206	Shadow or Pilot Vehicle	15.00	0.00	15.00
207	Truck Mechanic	19.50	4.97	24.47

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer	26.15	12.29	38.44
303	Landscaper	23.71	15.07	38.78
304	Flagperson or Traffic Control Person	12.00	17.89	29.89
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	16.51	0.00	16.51
314	Railroad Track Laborer	14.00	4.77	18.77

HEAVY EQUIPMENT OPERATORS
CONCRETE PAVEMENT OR BRIDGE WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
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. Future Increase(s): Add $2/hr on 6/1/12; Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): 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 $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	34.22	18.90	53.12
542	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 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. Future Increase(s): Add $2/hr on 6/1/12; Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): 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 $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	33.72	18.90	52.62

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
543	Air Track, Rotary or Percussion Drilling Machine &/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. & 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 & 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; 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 & A-Frames. Future Increase(s): Add $2/hr on 6/1/12; Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): 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 $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	33.22	18.90	52.12

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
544	Backfiller; Belting, Burlap, Texturing Machine; 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 (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Jeep Digger; Joint Sawer (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. Future Increase(s): Add $2/hr on 6/1/12; Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): 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 $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	33.22	18.90	52.12
545	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; 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.	30.42	17.58	48.00
546	Fiber Optic Cable Equipment.	22.00	7.27	29.27
547	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	36.20	18.81	55.01
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.	36.20	18.81	55.01
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.	26.80	18.52	45.32
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.	26.80	18.52	45.32

HEAVY EQUIPMENT OPERATORS
ASPHALT PAVEMENT OR OTHER WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
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.	34.62	17.96	52.58
552	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 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. Future Increase(s): Add $2/hr on 6/1/12; Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14. Premium Increase(s): 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 $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	33.72	18.90	52.62

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
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. Future Increase(s): Add $2/hr on 6/1/12; Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14.	32.67	18.55	51.22
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 Sawer (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.	31.52	17.89	49.41
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. Future Increase(s): Add $2/hr on 6/1/12; Add $2/hr on 6/1/13; Add $1.75/hr on 6/1/14.	32.67	18.55	51.22
556	Fiber Optic Cable Equipment.	22.00	7.27	29.27

RESIDENTIAL OR AGRICULTURAL CONSTRUCTION

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.

SKILLED TRADES

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
101	Acoustic Ceiling Tile Installer	27.00	2.47	29.47
102	Boilermaker	31.09	23.75	54.84
103	Bricklayer, Blocklayer or Stonemason	32.00	3.00	35.00
104	Cabinet Installer	22.00	2.74	24.74
105	Carpenter	27.00	3.46	30.46
106	Carpet Layer or Soft Floor Coverer	23.95	2.78	26.73
107	Cement Finisher	21.33	4.25	25.58
108	Drywall Taper or Finisher	23.80	1.55	25.35
109	Electrician	22.00	9.18	31.18
110	Elevator Constructor	43.79	25.48	69.27
111	Fence Erector	17.64	4.33	21.97
112	Fire Sprinkler Fitter	36.39	16.97	53.36
113	Glazier	36.23	11.22	47.45
114	Heat or Frost Insulator	29.04	19.73	48.77
115	Insulator (Batt or Blown)	18.95	1.70	20.65
116	Ironworker	30.90	19.11	50.01
117	Lather	28.15	15.14	43.29
119	Marble Finisher	31.16	16.27	47.43
120	Marble Mason	32.66	16.20	48.86
121	Metal Building Erector	17.50	2.80	20.30
123	Overhead Door Installer	17.00	0.00	17.00
124	Painter	25.65	6.33	31.98
125	Pavement Marking Operator	26.00	0.00	26.00

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
129	Plasterer	19.00	0.29	19.29
130	Plumber	30.00	10.34	40.34
132	Refrigeration Mechanic	30.96	0.00	30.96
133	Roofer or Waterproofer	29.85	1.55	31.40
134	Sheet Metal Worker	21.03	3.40	24.43
135	Steamfitter	32.59	11.05	43.64
137	Teledata Technician or Installer	19.23	5.32	24.55
138	Temperature Control Installer	22.45	4.11	26.56
139	Terrazzo Finisher	18.00	5.35	23.35
140	Terrazzo Mechanic	31.16	16.27	47.43
141	Tile Finisher	23.96	13.36	37.32
142	Tile Setter	21.00	0.00	21.00
143	Tuckpointer, Caulker or Cleaner	23.96	12.88	36.84
146	Well Driller or Pump Installer	15.10	12.38	27.48
147	Siding Installer	18.80	1.42	20.22

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	19.86	2.54	22.40
203	Three or More Axle	19.50	14.27	33.77
205	Pavement Marking Vehicle	19.25	10.84	30.09
207	Truck Mechanic	19.00	1.75	20.75

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer	16.09	7.18	23.27
302	Asbestos Abatement Worker	17.00	2.21	19.21
303	Landscaper	25.00	0.54	25.54

311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	16.51	0.00	16.51

HEAVY EQUIPMENT OPERATORS
RESIDENTIAL OR AGRICULTURAL CONSTRUCTION

Fringe Benefits Must Be Paid On All Hours Worked

CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
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, Timbco, 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.	29.45	15.37	44.82
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.	26.45	14.35	40.80

********** END OF RATES **********