



# BREESE STEVENS FIELD CONCESSION AND RESTROOM BUILDING

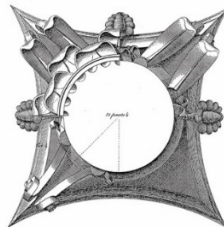
CITY OF MADISON CONTRACT: 8222

MUNIS: 17158 -51 -140

## PROJECT MANUAL

07-12-2018

ISTHMUS  
ARCHITECTURE, INC.





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## SECTION 01 22 00

### UNIT PRICES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for unit prices.
- B. Related Sections include the following:
  - 1. Division 01 Section "Allowances" for procedures for using unit prices to adjust quantity allowances.
  - 2. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
  - 3. Division 01 Section "Quality Requirements" for general testing and inspecting requirements.

##### 1.3 DEFINITIONS

- A. Unit price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

##### 1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A list of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

- A. Masonry Repointing: Cost per square foot to repoint existing masonry per Specifications.

END OF SECTION

## SECTION 012300

### ALTERNATES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for alternates.

##### 1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate 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 integrate work of the alternate into Project.
  - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Add Alternate 1 – Façade and Gutters, 1925 Grandstand
  - 1. Base Bid: No Work.
  - 2. Alternate: ADD to fully complete façade and gutter work per Drawings and Specifications.
  
- B. Add Alternate 2 – North Dugout Repair/Restoration
  - 1. Base Bid: No Work.
  - 2. Alternate: ADD to fully complete repairs to 1934 dugout area per Drawings and Specifications.
  
- C. Add Alternate 3 – Alternate Connection to Existing Sanitary Service
  - 1. Base Bid: Use existing sewer lateral.
  - 2. Alternate: ADD to connect into the sewer main per Drawings and Specifications.

END OF SECTION

## SECTION 01 26 00

### CONTRACT MODIFICATION PROCEDURES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections include the following:
  - 1. Division 01 Section "Allowances" for procedural requirements for handling and processing allowances.
  - 2. Division 01 Section "Unit Prices" for administrative requirements for using unit prices.
  - 3. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

##### 1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, in the form of a construction bulletin.

##### 1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: City of Madison Project Manager will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Proposal Requests issued by the City of Madison Project Manager are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
  - 2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

- a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
  - c. Include costs of labor and supervision directly attributable to the change.
  - d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to City of Madison Project Manager.
- 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
  - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
  - 4. Include costs of labor and supervision directly attributable to the change.
  - 5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  - 6. Comply with requirements in Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
- C. Proposal Request Form: Use AIA Document G709 for Proposal Requests or other similar document.

## 1.5 ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, base each Change Order proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
- 1. Include installation costs in purchase amount only where indicated as part of the allowance.
  - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
  - 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
  - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 7 days of receipt of the Change Order or Construction Change Directive authorizing work to proceed. Owner will reject claims submitted later than 7 days after such authorization.
  - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
  - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

#### 1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, City of Madison Project Manager will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

#### 1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION





## SECTION 01 31 00

### PROJECT MANAGEMENT AND COORDINATION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Coordination Drawings.
  - 2. Administrative and supervisory personnel.
  - 3. Project meetings.
  - 4. Requests for Interpretation (RFIs).
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.
- C. Related Sections include the following:
  - 1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
  - 2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

##### 1.3 COORDINATION

- A. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.

4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
  2. Preparation of the Schedule of Values.
  3. Installation and removal of temporary facilities and controls.
  4. Delivery and processing of submittals.
  5. Mock-Up Inspections and Procedures
  6. Progress meetings.
  7. Startup and adjustment of systems.
  8. Project closeout activities.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

#### 1.4 SUBMITTALS

- A. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

#### 1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.
1. Include special personnel required for coordination of operations with other contractors.

## 1.6 PROJECT MEETINGS

- A. General: Contractor shall schedule and conduct meetings at Project site, unless otherwise indicated. Contractor shall also perform the following duties as required:
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner, Owner's Construction Manager and Architect of scheduled meeting dates and times.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within five days of the meeting. Minutes of meetings are to be recorded by either the Contractor or the Construction Manager. Contractor and Construction Manager must determine who is responsible for producing and distributing meeting minutes.
- B. Preconstruction Conference: Owner shall schedule a preconstruction conference before starting construction, at a time convenient Contractor and Architect, but no later than 7 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Contractor shall conduct the meeting to review responsibilities and personnel assignments.
1. Attendees: Authorized representatives; Owner's Construction Manager, Architect, Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Contractor shall discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long-lead items.
    - d. Designation of key personnel and their duties.
    - e. Procedures for processing field decisions and Change Orders.
    - f. Traffic Control plans of Contractor.
    - g. Haul Routes proposed by Contractor.
    - h. Disposal sites proposed by Contractor.
    - i. Erosion Control Plans of the Contractor.
    - j. Measurement of Quantities.
    - k. Drawings and Specifications.
    - l. Material Certificates.
    - m. Certificates of Insurance of Contractor and all Subcontractors.
    - n. Procedures for requests for interpretations (RFIs).
    - o. Procedures for testing and inspecting.
    - p. Procedures for conducting Mock-up panels.
    - q. Procedures for processing Applications for Payment.
    - r. Distribution of the Contract Documents.
    - s. Submittal procedures.
    - t. Preparation of Record Documents.
    - u. Use of the premises.
    - v. Work restrictions.
    - w. Owner's occupancy requirements.

- x. Responsibility for temporary facilities and controls.
  - y. Parking availability.
  - z. Office, work, and storage areas.
  - aa. Equipment deliveries and priorities.
  - bb. First aid.
  - cc. Security.
  - dd. Progress cleaning.
  - ee. Working hours.
3. Minutes: Contractor shall Record and distribute meeting minutes.
- C. Progress Meetings: Contractor shall conduct progress meetings at intervals agreed upon by the Owner, Architect and the Contractor. Meetings shall be scheduled for no less than one meeting per calendar month. Contractor shall coordinate dates of meetings with preparation of payment requests.
- 1. Attendees: In addition to representatives of Owner, Architect and each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 2. Agenda: Attendees shall review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Contractor shall lead discussions to review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Deliveries.
      - 5) Off-site fabrication.
      - 6) Access.
      - 7) Site utilization.
      - 8) Temporary facilities and controls.
      - 9) Work hours.
      - 10) Hazards and risks.
      - 11) Progress cleaning.
      - 12) Quality and work standards.
      - 13) Status of correction of deficient items.
      - 14) Field observations.

- 15) Requests for interpretations (RFIs).
  - 16) Status of proposal requests.
  - 17) Pending changes.
  - 18) Status of Change Orders.
  - 19) Pending claims and disputes.
  - 20) Documentation of information for payment requests.
  - 21) Review of Mock-ups.
3. Minutes: Contractor shall Record and distribute meeting minutes.
  
  4. Reporting: Contractor shall distribute minutes of the meeting to each party present and to parties who should have been present.
    - a. Schedule Updating: Contractor shall revise the Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION



## SECTION 01 32 00

### CONSTRUCTION PROGRESS DOCUMENTATION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Material location reports.
6. Field condition reports.
7. Special reports.

- B. Related Sections include the following:

1. Division 01 Section "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.
2. Division 01 Section "Payment Procedures" for submitting the Schedule of Values.
3. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
4. Division 01 Section "Photographic Documentation" for submitting construction photographs.
5. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
6. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

##### 1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
  1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
  2. Predecessor Activity: An activity that precedes another activity in the network.
  3. Successor Activity: An activity that follows another activity in the network.

- B. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Architect.
- C. Major Area: A story of construction, a separate building, or a similar significant construction element.
- D. Milestone: A key or critical point in time for reference or measurement.
- E. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.
- F. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

#### 1.4 SUBMITTALS

- A. Contractor's Construction Schedule: Submit opaque copies of initial schedule, large enough to show entire schedule for entire construction period. Submit two copies to each the Owner, Construction Manager and the Architect.

#### 1.5 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
  - 1. Secure time commitments for performing critical elements of the Work from parties involved.
  - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

### PART 2 - PRODUCTS

#### 2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
  - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.



- C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
    - a. Procurement Activities: Include procurement process activities long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule.
  2. Startup and Testing Time: Include not less than 3 days for startup and testing.
  3. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and City of Madison Project Manager's administrative procedures necessary for certification of Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- E. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
1. Refer to Division 01 Section "Payment Procedures" for cost reporting and payment procedures.
  2. Contractor shall assign cost to construction activities on the CPM schedule. Costs shall not be assigned to submittal activities unless specified otherwise but may, with Architect's approval, be assigned to fabrication and delivery activities. Costs shall be under required principal subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
  3. Each activity cost shall reflect an accurate value subject to approval by Architect.
  4. Total cost assigned to activities shall equal the total Contract Sum.
- F. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

## 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 5 days of date established for commencement of the Work. Base schedule on the Preliminary Construction Schedule and whatever up-dating and feedback was received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

## 2.3 SPECIAL REPORTS

- A. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report when requested by Architect or City of Madison Project Manager. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule three days before each regularly scheduled progress meeting.
  - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  - 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to City of Madison Project Manager, Owner and Architect, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
  - 1. Post copies in Project meeting rooms and temporary field offices.
  - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION

## SECTION 01 33 00

### SUBMITTAL PROCEDURES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals. Shop Drawings, Product Data, Samples and other submittals shall be submitted to the Architect for review and approval.
- B. Related Sections include the following:
  - 1. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
  - 2. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
  - 3. Division 01 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
  - 4. Division 01 Section "Closeout Procedures" for submitting warranties.
  - 5. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 6. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
  - 7. Divisions 02 through 49 Sections for specific requirements for submittals in those Sections.

##### 1.3 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Documents may be provided by Architect for Contractor's use in preparing submittals.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

- C. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 5 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 5 days for review of each resubmittal.
  4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 15 days for initial review of each submittal.
  5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- E. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
  2. Provide a space approximately 4 by 4 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
  3. Include the following information on label for processing and recording action taken:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect.
    - d. Name and address of Contractor.
    - e. Name and address of subcontractor.
    - f. Name and address of supplier.
    - g. Name of manufacturer.
    - h. Submittal number or other unique identifier, including revision identifier.
      - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).
- F. Deviations: Encircle or otherwise specifically identify deviations from the Contract Documents on submittals.

- G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
  - 1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
  - 2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review received from sources other than Contractor.
  - 1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  - 1. Note date and content of previous submittal.
  - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  - 3. Resubmit submittals until they are marked "Approved" or "Approved as noted".
- J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- K. Use for Construction: Use only final submittals with mark indicating "Approved" or "Approved as noted".

## PART 2 - PRODUCTS

### 2.1 SUBMITTALS

- A. General: Prepare and submit Submittals required by individual Specification Sections.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
  - 3. Include the following information, as applicable:
    - a. Manufacturer's written recommendations.
    - b. Manufacturer's product specifications.

- c. Manufacturer's installation instructions.
  - d. Standard color charts.
  - e. Manufacturer's catalog cuts.
  - f. Wiring diagrams showing factory-installed wiring.
  - g. Printed performance curves.
  - h. Operational range diagrams.
  - i. Mill reports.
  - j. Standard product operation and maintenance manuals.
  - k. Compliance with specified referenced standards.
  - l. Testing by recognized testing agency.
  - m. Application of testing agency labels and seals.
  - n. Notation of coordination requirements.
- 4. Submit Product Data before or concurrent with Samples.
  - 5. Number of Copies: Submit four copies of Product Data, unless otherwise indicated. Architect will return two copies. Mark up and retain one returned copy as a Project Record Document.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
- 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Dimensions.
    - b. Identification of products.
    - c. Fabrication and installation drawings.
    - d. Roughing-in and setting diagrams.
    - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
    - f. Shopwork manufacturing instructions.
    - g. Templates and patterns.
    - h. Schedules.
    - i. Design calculations.
    - j. Compliance with specified standards.
    - k. Notation of coordination requirements.
    - l. Notation of dimensions established by field measurement.
    - m. Relationship to adjoining construction clearly indicated.
    - n. Seal and signature of professional engineer if specified.
    - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
  - 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 11 by 17 inches.
  - 3. Number of Copies: Submit four opaque (bond) copies of each submittal. Architect will return two copies.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of appropriate Specification Section.
  3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  4. Samples for Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
  5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit four sets of Samples. Architect will retain two Sample sets; remainder will be returned.
      - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product.
  2. Number and name of room or space.

3. Location within room or space.
  4. Number of Copies: Submit four copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
    - a. Mark up and retain one returned copy as a Project Record Document.
- F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation" for Construction Manager's action.
- G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
1. Name, address, and telephone number of entity performing subcontract or supplying products.
  2. Number of Copies: Submit four copies of subcontractor list, unless otherwise indicated. Architect will return two copies.
    - a. Mark up and retain one returned copy as a Project Record Document.

## 2.2 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit four copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.



## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

### 3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp.
- C. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION



## SECTION 01 35 91

### HISTORIC TREATMENT PROCEDURES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes special procedures for historic treatment on Project including, but not limited to, the following:
  - 1. Storage and protection of existing historic materials.
  - 2. Temporary protection of historic materials during construction.
  - 3. Protection during application of chemicals.
  - 4. Protection during use of heat-generating equipment.
  - 5. Historic treatment procedures.
  - 6. Removal of bird excrement.

##### 1.3 DEFINITIONS

- A. "Preservation": To apply measures necessary to sustain the existing form, integrity, and materials of a historic property. Work may include preliminary measures to protect and stabilize the property.
- B. "Rehabilitation": To make possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features that convey its historical, cultural, or architectural values.
- C. "Restoration": To accurately depict the form, features, and character of a property as it appeared at a particular period of time by means of the removal of features from other periods in its history and the reconstruction of missing features from the restoration period.
- D. "Reconstruction": To reproduce in the exact form and detail a building, structure, or artifact as it appeared at a specific period in time.
- E. "Stabilize": To apply measures designed to reestablish a weather-resistant enclosure and the structural reinforcement of an item or portion of the building while maintaining the essential form as it exists at present.
- F. "Protect and Maintain": To remove deteriorating corrosion, reapply protective coatings, and install protective measures such as temporary guards; to provide the least degree of intervention.

- G. "Repair": To stabilize, consolidate, or conserve; to retain existing materials and features while employing as little new material as possible. Repair includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials. Within restoration, repair also includes limited replacement in kind, rehabilitation, and reconstruction, with compatible substitute materials for deteriorated or missing parts of features when there are surviving prototypes.
- H. "Replace": To duplicate and replace entire features with new material in kind. Replacement includes the following conditions:
  - 1. Duplication: Includes replacing elements damaged beyond repair or missing. Original material is indicated as the pattern for creating new duplicated elements.
  - 2. Replacement with New Materials: Includes replacement with new material when original material is not available as patterns for creating new duplicated elements.
  - 3. Replacement with Substitute Materials: Includes replacement with compatible substitute materials. Substitute materials are not allowed, unless otherwise indicated.
- I. "Remove": To detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- J. "Remove and Salvage": To detach items from existing construction and deliver them to Owner.
- K. "Remove and Reinstall": To detach items from existing construction, repair and clean them for reuse, and reinstall them where indicated.
- L. "Existing to Remain" or "Retain": Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled.
- M. "Material in Kind": Material that matches existing materials, as much as possible, in species, cut, color, grain, and finish.

#### 1.4 SUBMITTALS

- A. Alternative Methods and Materials: If alternative methods and materials to those indicated are proposed for any phase of work, provide a written description including evidence of successful use on other, comparable projects, and program of testing to demonstrate effectiveness for use on this Project.
- B. Qualification Data: For historic treatment specialists and supervisory personnel. Include list of completed projects with the scope of work and budget for each.

#### 1.5 QUALITY ASSURANCE

- A. Historic Treatment Preconstruction Conference: Conduct conference at Project site.
  - 1. Review manufacturer's written instructions for precautions and effects of products and procedures on building materials, components, and vegetation.
    - a. Record procedures established as a result of the review and distribute to affected parties.

## 1.6 STORAGE AND PROTECTION OF HISTORIC MATERIALS

### A. Removed and Salvaged Historic Materials:

1. Clean salvaged historic items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Protect items from damage during transport and storage.
5. Do not dispose of items removed from existing construction without prior written consent of Owner.

### B. Removed and Reinstalled Historic Materials:

1. Clean and repair historic items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

### C. Existing Historic Materials to Remain: Protect construction indicated to remain against damage and soiling during historic treatment. When permitted by Architect, items may be removed to a suitable, protected storage location during historic treatment and cleaned and reinstalled in their original locations after historic treatment operations are complete.

### D. Storage and Protection: When removed from their existing location, store historic materials within a weathertight enclosure where they are protected from wetting by rain, snow, or ground water, and temperature variations. Secure stored materials to protect from theft.

1. Identify removed items with an inconspicuous mark indicating their original location.

## 1.7 PROJECT-SITE CONDITIONS

### A. Exterior Cleaning and Repairing:

1. Proceed with the work only when forecasted weather conditions are favorable.
  - a. Wet Weather: Do not attempt repairs during rainy or foggy weather. Do not apply primer, paint, putty, or epoxy when the relative humidity is above 80 percent. Do not remove exterior elements of structures when rain is forecast or in progress.
  - b. Do not perform exterior wet work when the air temperature is below 40 deg F (5 deg C).
  - c. Do not begin cleaning, patching, or repairing when there is any likelihood of frost or freezing.
  - d. Do not begin cleaning when either the air or the surface temperature is below 45 deg F (7 deg C) unless approved means are provided for maintaining a 45 deg F (7 deg C) temperature of the air and materials during, and for 48 hours subsequent to, cleaning.
2. Perform cleaning and rinsing of the exterior only during daylight hours.

- B. Owner will occupy portions of building immediately adjacent to historic treatment area. Conduct historic treatment so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

## PART 2 - PRODUCTS - (Not Used)

## PART 3 - EXECUTION

### 3.1 PROTECTION, GENERAL

- A. Comply with manufacturer's written instructions for precautions and effects of products and procedures on adjacent building materials, components, and vegetation.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Temporary Protection of Historic Materials during Construction:
  - 1. Protect existing materials during installation of temporary protections and construction. Do not deface or remove existing materials.
  - 2. Attachments of temporary protection to existing construction shall be approved by Architect prior to installation.
- D. Existing Drains: Prior to the start of work or any cleaning operations, test drains and other water removal systems to ensure that drains and systems are functioning properly. Notify Architect immediately of drains or systems that are stopped or blocked. Do not begin Work of this Section until the drains are in working order.
  - 1. Provide a method to prevent solids including stone or mortar residue from entering the drains or drain lines. Clean out drains and drain lines that become blocked or filled by sand or any other solids because of work performed under this Contract.
  - 2. Protect storm drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

### 3.2 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site and surrounding buildings from harm or damage resulting from applications of chemical cleaners and paint removers.
- B. Cover adjacent surfaces with materials that are proven to resist chemical cleaners selected for Project unless chemicals being used will not damage adjacent surfaces. Use covering materials that contain only waterproof, UV-resistant adhesives. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
- C. Do not clean surfaces during winds of sufficient force to spread cleaning solutions to unprotected surfaces.

- D. Neutralize and collect alkaline and acid wastes and dispose of off Owner's property.
- E. Dispose of runoff from chemical operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

### 3.3 PROTECTION DURING USE OF HEAT-GENERATING EQUIPMENT

- A. Comply with the following procedures while performing work with heat-generating equipment, including welding, cutting, soldering, brazing, paint removal with heat, and other operations where open flames or implements utilizing heat are used:
  - 1. Obtain Owner's approval for operations involving use of open-flame or welding equipment.
    - a. Notification shall be given for each occurrence and location of work with heat-generating equipment.
  - 2. As far as practical, use heat-generating equipment in shop areas or outside the building.
  - 3. Before work with heat-generating equipment commences, furnish personnel to serve as a fire watch (or watches) for location(s) where work is to be performed.
  - 4. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
  - 5. Remove and keep the area free of combustibles, including, rubbish, paper, waste, etc., within area of operations.
    - a. If combustible material cannot be removed, provide fireproof blankets to cover such materials.
  - 6. Where possible, furnish and use baffles of metal or gypsum board to prevent the spraying of sparks or hot slag into surrounding combustible material.
  - 7. Prevent the extension of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
  - 8. Inspect each location of the day's work not sooner than 30 minutes after completion of operations to detect hidden or smoldering fires and to ensure that proper housekeeping is maintained.
- B. Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to automatic sprinkler heads, shield the individual heads temporarily with guards.

### 3.4 HISTORIC TREATMENT PROCEDURES

- A. The principal aim of preservation work is to halt the process of deterioration and stabilize the item's condition, unless otherwise indicated. Repair is required where specifically indicated. The following procedures shall be followed:
  - 1. Retain as much existing material as possible; repair and consolidate rather than replace.

2. Use additional material or structure to reinforce, strengthen, prop, tie, and support existing material or structure.
  3. Use reversible processes wherever possible.
  4. Use traditional replacement materials and techniques. New work shall be distinguishable to the trained eye, on close inspection, from old work.
  5. Record the work before the procedure with preconstruction photos and during the work with periodic construction photos.
- B. Obtain Architect's review and written approval in the form of a Constructive Change Directive or Supplemental Instruction before making changes or additions to construction or removing historic materials.
- C. Notify Architect of visible changes in the integrity of material or components whether due to environmental causes including biological attack, UV degradation, freezing, or thawing; or due to structural defects including cracks, movement, or distortion.
1. Do not proceed with the work in question until directed by Architect.
- D. Where missing features are indicated to be repaired or replaced, provide features whose designs are based on accurate duplications rather than on conjectural designs, subject to the approval of Architect and Preservation Specialist.
- E. Where Work requires existing features to be removed, cleaned, and reused, perform these operations without damage to the material itself, to adjacent materials, or to the substrate.
- F. When cleaning, match samples of existing materials that have been cleaned and identified for acceptable cleaning levels. Avoid overcleaning to prevent damage to existing materials during cleaning.

### 3.5 REMOVAL OF BIRD EXCREMENT

- A. General: Before disturbing accumulated bird excrement, consult with an occupational medicine physician, industrial hygienist, and authorities having jurisdiction to determine acceptable removal procedures and appropriate protective measures for personnel.
- B. Removing Bird Excrement: Treat bird excrement before its removal as required by authorities having jurisdiction.
1. Prior to removal, dampen excrement to prevent it from becoming airborne.
  2. Use only nonmetallic tools (plastic spatulas and brushes with natural fiber or nylon bristles, or their equivalent) to remove excrement.
  3. Collect removed excrement and legally disposed of off site.
  4. Perform bird excrement removal work from the outside of the building with windows and other openings in the building closed.

END OF SECTION



## SECTION 01 40 00

### QUALITY REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

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

- C. Related Sections include the following:

- 1. Division 01 Section "Allowances" for testing and inspecting allowances.
- 2. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
- 3. Division 01 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
- 4. Divisions 02 through 49 Sections for specific test and inspection requirements.

##### 1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed

construction comply with requirements. Services do not include contract enforcement activities performed by Architect or City of Madison Project Manager.

- C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.
- D. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- J. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of 2 previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

#### 1.4 CONFLICTING REQUIREMENTS

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

To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

## 1.5 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

## 1.6 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
  2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
    - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
  2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
  2. Notify Architect and City of Madison Project Manager seven days in advance of dates and times when mockups will be constructed.
  3. Demonstrate the proposed range of aesthetic effects and workmanship.
  4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.
  5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  6. Demolish and remove mockups when directed, unless otherwise indicated.

## 1.7 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
  3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
  3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.

3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 15 days of date established for commencement of the Work.
1. Distribution: Distribute schedule to Owner, Architect, City of Madison Project Manager testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 TEST AND INSPECTION LOG

- A. Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
  2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Architect.

4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's and City of Madison Project Manager reference during normal working hours.

### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
  2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION





## SECTION 01 42 00

### REFERENCES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

### 1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
  - 2. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

### 1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale Research's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

ADAAG	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities Available from Access Board <a href="http://www.access-board.gov">www.access-board.gov</a>	(800) 872-2253 (202) 272-0080
AAMA	American Architectural Manufacturers Association <a href="http://www.aamanet.org">www.aamanet.org</a>	(847) 303-5664
ACI	ACI International (American Concrete Institute) <a href="http://www.aci-int.org">www.aci-int.org</a>	(248) 848-3700
AGC	Associated General Contractors of America (The) <a href="http://www.agc.org">www.agc.org</a>	(703) 548-3118
AIA	American Institute of Architects (The) <a href="http://www.aia.org">www.aia.org</a>	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction	(800) 644-2400

	www.aisc.org	(312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
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
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9585
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
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
MH	Material Handling	

(Now MHIA)

MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(312) 332-0405
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NGA	National Glass Association www.glass.org	(703) 442-4890
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
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
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
UL	Underwriters Laboratories Inc. www.ul.com	(800) 285-4476 (847) 272-8800
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
ICC	International Code Council (Formerly: CABO - Council of American Building Officials)	

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION



## SECTION 01 50 00

### TEMPORARY FACILITIES AND CONTROLS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections include the following:
  - 1. Division 01 Section "Summary" for limitations on utility interruptions and other work restrictions.
  - 2. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
  - 3. Division 01 Section "Execution" for progress cleaning requirements.
  - 4. Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

##### 1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

##### 1.4 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water service use charges for water used by all entities for construction operations.

- D. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

## 1.5 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

## 1.6 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

## 1.7 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

## PART 2 - PRODUCTS

### 2.1 TEMPORARY FACILITIES

- A. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
  - 1. Store combustible materials apart from building.

### 2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. Heating Equipment: Unless Owner authorizes use of permanent heating system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.



## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
  - 1. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- G. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.

- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
  - 2. Install lighting for Project identification sign.
- I. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
  - 1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
  - 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Use areas designated by owner as parking areas for construction personnel as agreed upon at the pre-construction conference.
- D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
  - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
  - 2. Remove snow and ice as required to minimize accumulations.
- E. Project Identification and Temporary Signs: Provide Project identification and other signs. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
  - 1. Provide temporary, directional signs for construction personnel and visitors.
  - 2. Maintain and touchup signs so they are legible at all times.
- F. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
  - J. Existing Stair Usage: Use of Owner's existing stairs will be permitted, as long as stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
    1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If, despite such protection, stairs become damaged, restore damaged areas so no evidence remains of correction work.
  - K. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

#### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  1. Comply with work restrictions specified in Division 01 Section "Summary."
- B. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Division 31 Section "Site Clearing."
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
  1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Comply with requirements specified in Division 01 Section "Temporary Tree and Plant Protection."
- F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- G. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial

Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

- H. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
  - 1. Extent of Fence: As indicated on Drawings.
  - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.
- I. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
  - 1. Prohibit smoking in construction areas.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

- C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  - 2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
  - 3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION



## SECTION 01 60 00

### PRODUCT REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
  - 1. Division 01 Section "Allowances" for products selected under an allowance.
  - 2. Division 01 Section "Alternates" for products selected under an alternate.
  - 3. Division 01 Section "References" for applicable industry standards for products specified.
  - 4. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
  - 5. Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

##### 1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

#### 1.4 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
  - 1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
  - 2. Form: Tabulate information for each product under the following column headings:
    - a. Specification Section number and title.
    - b. Generic name used in the Contract Documents.
    - c. Proprietary name, model number, and similar designations.
    - d. Manufacturer's name and address.
    - e. Supplier's name and address.
    - f. Installer's name and address.
    - g. Projected delivery date or time span of delivery period.
    - h. Identification of items that require early submittal approval for scheduled delivery date.
- B. Substitution Requests: Submit four copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use form developed by Contractor.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified material or product cannot be provided.
    - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.



- h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
          - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
          - j. Cost information, including a proposal of change, if any, in the Contract Sum.
          - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
          - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
  - 3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 7 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
    - a. Form of Acceptance: Change Order.
    - b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

## 1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
  - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
  - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

## 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

## 1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. **Manufacturer's Warranty:** Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  2. **Special Warranty:** Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. **Special Warranties:** Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. **Manufacturer's Standard Form:** Modified to include Project-specific information and properly executed.
  2. **Specified Form:** When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
  3. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. **Submittal Time:** Comply with requirements in Division 01 Section "Closeout Procedures."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
  6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
  7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
  2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
  3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
  4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
  5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
  6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
  7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
  8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in

Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.

9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
  - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
  - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
  - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received within 30 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
  1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
  2. Requested substitution does not require extensive revisions to the Contract Documents.
  3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  4. Substitution request is fully documented and properly submitted.
  5. Requested substitution will not adversely affect Contractor's Construction Schedule.
  6. Requested substitution has received necessary approvals of authorities having jurisdiction.
  7. Requested substitution is compatible with other portions of the Work.
  8. Requested substitution has been coordinated with other portions of the Work.
  9. Requested substitution provides specified warranty.
  10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

## 2.3 COMPARABLE PRODUCTS

- A. Conditions: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
  5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION



## SECTION 01 73 00

### EXECUTION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

- B. Related Sections include the following:

1. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 01 Section "Submittal Procedures" for submitting surveys.
3. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
4. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

##### 1.3 SUBMITTALS

- A. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
  2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
    - a. Description of the Work.
    - b. List of detrimental conditions, including substrates.
    - c. List of unacceptable installation tolerances.
    - d. Recommended corrections.
  2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility



appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

### 3.3 CONSTRUCTION LAYOUT

- A. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- B. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

### 3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect and City of Madison Project Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and City of Madison Project Manager before proceeding.
  - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

### 3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  1. Make vertical work plumb and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  2. Allow for building movement, including thermal expansion and contraction.
  3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

### 3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

### 3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

## SECTION 01 73 29

### CUTTING AND PATCHING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
  - 1. Division 01 Section "Selective Removal" for demolition of selected portions of the building.
  - 2. Divisions 2 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
  - 3. Division 07 Section "Penetration Firestopping" for patching fire-rated construction.

##### 1.3 DEFINITIONS

- A. Cutting: Removal of in-place 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 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.
- 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. Operating elements include the following:
  - 1. Primary operational systems and equipment.
  - 2. Air or smoke barriers.
  - 3. Mechanical systems piping and ducts.
  - 4. Control systems.
  - 5. Communication systems.
  - 6. Electrical wiring systems.

- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:
  - 1. Water, moisture, or vapor barriers.
  - 2. Membranes and flashings.
  - 3. Piping, ductwork, vessels, and equipment.
- 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.
- E. Cutting and Patching Conference: At Progress Meeting prior to commencement of Cutting and Patching, 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.

## 1.5 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.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place 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 in-place 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 in-place 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 in-place 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.

### 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 in-place 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.
- B. Cutting: Cut in-place 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. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Concrete & 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.
  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.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  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 in-place 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 and repair 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.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION



## SECTION 01 77 00

### CLOSEOUT PROCEDURES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Inspection procedures.
  - 2. Warranties.
  - 3. Final cleaning.
- B. Related Sections include the following:
  - 1. Division 01 Section "Execution" for progress cleaning of Project site.
  - 2. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
  - 3. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

##### 1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
  - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  - 2. Advise Owner of pending insurance changeover requirements.
  - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
  - 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  - 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

#### 1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit a consolidated list of all extra and additional materials left to owner's possession following Final Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

## 1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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

## 1.6 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

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

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Remove snow and ice to provide safe access to building.
    - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Sweep concrete floors broom clean in unoccupied spaces.
    - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
    - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    - k. Remove labels that are not permanent.
    - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
      - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
    - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    - n. Replace parts subject to unusual operating conditions.
    - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
    - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

- s. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION



## SECTION 01 78 23

### OPERATION AND MAINTENANCE DATA

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory.
  - 2. Emergency manuals.
  - 3. Operation manuals for systems, subsystems, and equipment.
  - 4. Maintenance manuals for the care and maintenance of products, materials, and finishes, systems and equipment.
- B. Related Sections include the following:
  - 1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
  - 2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
  - 3. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

##### 1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

##### 1.4 SUBMITTALS

- A. Final Submittal: Submit one copy of each manual in final form at least 15 days before final inspection.

## 1.5 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

## PART 2 - PRODUCTS

### 2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
  - 1. List of documents.
  - 2. List of systems.
  - 3. List of equipment.
  - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

### 2.2 MANUALS, GENERAL

- A. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

### 2.3 EMERGENCY MANUALS

- A. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- B. Emergency Procedures: Include the following, as applicable:
  - 1. Instructions on stopping.
  - 2. Shutdown instructions for each type of emergency.



3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

## 2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions.
  2. Performance and design criteria if Contractor is delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Piped system diagrams.
  9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.
  8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

## 2.5 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

## 2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard printed maintenance instructions and bulletins.
  2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  3. Identification and nomenclature of parts and components.
  4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
  2. Troubleshooting guide.
  3. Precautions against improper maintenance.
  4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  5. Aligning, adjusting, and checking instructions.
  6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

## PART 3 - EXECUTION

### 3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
  - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
  - 2. Comply with requirements of newly prepared Record Drawings in Division 01 Section "Project Record Documents."
- G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

### 3.2 REVIEW MEETING

- A. At Substantial Completion coordinate with the Architect, Owner's Representative and all applicable building occupants to review the Operation and Maintenance Data Manual at an on-site meeting. Discuss the following topics.
  - 1. Review contents of the Manual.
  - 2. Provide overview training on operation and maintenance data using the Manual as a reference. Locate all systems and equipment for meeting attendees and provide basic training on the operation and control of the systems.
  - 3. Answer all questions related to the Operation and Maintenance Manual.

END OF SECTION

## SECTION 01 78 39

### PROJECT RECORD DOCUMENTS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
- B. Related Sections include the following:
  - 1. Division 01 Section "Closeout Procedures" for general closeout procedures.
  - 2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 3. Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

##### 1.3 SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one original set of marked-up Record Prints and one copy of marked-up Record Prints to Owner. Submit one copy of marked-up Record Prints to Architect.

#### PART 2 - PRODUCTS

##### 2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
  - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether

individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

- a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
  - b. Accurately record information in an understandable drawing technique.
  - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
2. Content: Types of items requiring marking include, but are not limited to, the following:
- a. Dimensional changes to Drawings.
  - b. Revisions to details shown on Drawings.
  - c. Depths of foundations below first floor.
  - d. Locations and depths of underground utilities.
  - e. Revisions to routing of piping and conduits.
  - f. Revisions to electrical circuitry.
  - g. Actual equipment locations.
  - h. Duct size and routing.
  - i. Locations of concealed internal utilities.
  - j. Changes made by Change Order or Construction Change Directive.
  - k. Changes made following Architect's written orders.
  - l. Details not on the original Contract Drawings.
  - m. Field records for variable and concealed conditions.
  - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing Record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
  2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared Record Drawings into Record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: As follows:
  - a. Project name.
  - b. Date.
  - c. Designation "PROJECT RECORD DRAWINGS."
  - d. Name of Architect.
  - e. Name of Contractor.

## 2.2 MISCELLANEOUS RECORD SUBMITTALS

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

## PART 3 - EXECUTION

### 3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION





## SECTION 02 41 16

### SELECTIVE REMOVAL

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Selective removal of building elements.
2. Disconnecting, capping or sealing site utilities.

##### 1.2 SUBMITTALS

- A. Schedule of selective removal with starting and ending dates for each activity.
- B. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

##### 1.3 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
- D. Pre-removal Conference: Conduct conference at Project site.

##### 1.4 PROJECT CONDITIONS

- A. Building areas identified for selective removal will be vacated and their use discontinued before start of the Work.
- B. Properties immediately adjacent to demolition area will be occupied. Conduct selective removal so operations of occupied buildings will not be disrupted.
  1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
  2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
    - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
- C. Hazardous Materials

1. 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.
- D. Sale of removed items or materials is not permitted.
- E. Arrange selective removal schedule so as not to interfere with operations of adjacent occupied buildings.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Inventory and record the condition of items to be removed and salvaged.

### 3.2 PREPARATION

- A. Refrigerant: Remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction before starting demolition.
- B. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
  1. Arrange to shut off indicated utilities with utility companies.
  2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
  3. Cut off pipe or conduit a minimum of 24 inches (610 mm) below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
  4. Do not start demolition work until utility disconnecting and sealing have been completed.
- C. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

### 3.3 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, building entries, and other building facilities during selective removal operations. Maintain exits from existing buildings.
- B. Existing Utilities: Maintain utility services to remain and protect from damage during selective removal operations. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.

- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
  - 1. Protect adjacent buildings and facilities from damage due to selective removal activities.
  - 2. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings.
  - 3. Protect walls and other adjacent construction that are to remain and that are exposed to building demolition operations.
  - 4. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

### 3.4 SELECTIVE REMOVAL

- A. General: Remove indicated building elements completely. Use methods required to complete the Work within limitations of governing regulations.
  - 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
  - 2. Maintain adequate ventilation when using cutting torches.
  - 3. Locate any necessary equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
  - 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
- C. Existing Utilities: Terminate existing utilities and below-grade utility structures within 5 feet (1.5 m) outside footprint indicated for new construction.
- D. Below-Grade Areas: Completely fill below-grade areas and voids resulting from selective removal operations.
- E. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.
- F. Promptly repair damage to adjacent buildings caused by selective removal operations.

### 3.5 CLEANING

- A. Remove waste materials from Project site and legally dispose of them in an EPA-approved landfill acceptable to authorities having jurisdiction.
- B. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective removal operations. Return adjacent areas to condition existing before selective removal operations began.

END OF SECTION

## SECTION 02 41 17

### REMOVAL OF EXISTING CONCRETE AND SURFACE PREPARATION

#### PART 1 – GENERAL

##### 1.1 SCOPE OF WORK

- A. Removal of existing concrete in areas of deterioration
- B. Surface preparation for repairs and coatings as shown on the Drawings

##### 1.2 RELATED WORK

- A. Applicable provisions of Division 01 shall govern work of this section.
- B. Related work specified elsewhere:
  - 1. Section 07 18 00 – Traffic Coatings
  - 2. Section 07 95 01 – Expansion Joint Systems

##### 1.3 SUMMARY

- A. Include the removal of unsound concrete, grout, mortar, or epoxy-modified grout header material, as well as saw-cutting of existing concrete to widen expansion joints, in addition to cleaning of the newly exposed underlying sound concrete prior to installing new expansion joint systems and/or associated header material.
- B. Include shotblasting of the concrete surfaces as required by expansion joint or coating system manufacturer.
- C. The removal work shall be carried out in a manner so as to create a minimum disturbance with the continued use of the facility. Access to enclosed spaces below the work areas will be provided as needed.

##### 1.4 QUALITY ASSURANCE

- A. Pre-Construction Meeting: A pre-construction meeting is required with Contractor in order to coordinate work schedule and inspection required by Engineer.
- B. Installer Qualifications: Concrete repair work shall be performed under the immediate control of a person experienced in this type of work. The superintendent assigned to this project shall have a minimum of 5 years of experience on projects of similar magnitude and scope and shall be present during the work.

## 1.5 DEFINITIONS

- A. UNSOUND CONCRETE - Concrete which contains internal and/or surface cracking or loss of density, and which in the judgment of the Engineer is detrimental to the strength and serviceability of the structure. Unsound concrete is also associated with concrete surface spalling and crumbling, infiltration of moisture and salts, corrosion of reinforcement, rust staining, increased porosity, and reduced strength.
- B. SOUND CONCRETE - Firm, dense, homogeneous concrete which contains in the judgment of the Engineer no significant detriments to its strength or serviceability.
- C. REMOVAL - Removal of unsound and sound concrete, epoxy patches and asphalt using chipping hammers or other means.
- D. SCARIFYING - The process of making numerous cuts into a concrete surface, which results in fracturing the cement paste and aggregate, exposing a new roughened surface free of contaminants.

## 1.6 MEASUREMENT OF QUANTITIES (UNIT PRICE WORK)

- A. Payment for work to be performed on a unit price basis shall be made for work actually performed, based on quantities recorded by the Contractor and approved by the Engineer. Unless stated otherwise, records shall consist of both plan view drawings and tables cross-referenced to the drawings with the required measured quantities. Unless otherwise stated, the Engineer will verify the accuracy of the record by visual examination of the work performed and measuring the quantities with a measuring tape, wheel, or other appropriate device.
- B. The Contractor shall notify the Owner and the Engineer at once in writing of any unit price work that deviates materially from the prescribed basis for bidding and for which an adjustment in Unit Price is desired. The Contractor shall measure and quantify all such deviations, subject to the Engineer's verification, prior to any repair work which might make verification impossible. No adjustments in Unit Prices will be considered unless supporting field measurements are provided, and subject to the Owner's prior approval. Adjustments will only be considered if all repairs of a given type have been measured and all deviations, both plus and minus have been included in the determination of the average deviation from the Unit Price basis.
- C. Removal of concrete: The Contractor shall maintain a record of the location and quantity of concrete removed. The quantities shall be reported in the form of 1/4" = 1'-0" scale drawings along with tables cross-referenced to the drawings.
- D. Note that removal of concrete as needed to widen the existing expansion joint is considered to be part of the base bid requirements for installing the new expansion joint and thus would not trigger unit work payment.

## PART 2 – PRODUCTS

### 2.1 EQUIPMENT

- A. Use chipping hammers with a total weight not to exceed 15 pound class.
- B. Shotblast equipment shall be capable of lightly abrading new and existing concrete surface to remove surface contaminants and cleaning the concrete surface.
- C. Scabblers equipment shall be capable of abrading new and existing concrete surface to achieve required profile for applying coating materials.
- D. Sandblasting equipment shall be capable of removing rust from exposed reinforcement and laitance from newly exposed concrete surfaces.
- E. Compressed air equipment shall be capable of removal of dust and dirt from concrete repair areas.

## PART 3 – EXECUTION

### 3.1 CONCRETE REMOVAL

- A. Prior to removal, the Contractor shall submit the Contractor's plan for confining dust, collecting and disposal of broken concrete, steel reinforcement and other waste material as a result of the Contractor's removal operations. This plan shall be submitted to the Engineer and the Owner prior to start of construction.
- B. Contractor responsible for removing and reinstalling or protection in place of mechanical, electrical, and plumbing utilities including electrical lighting and conduits as required for repair work.
- C. Delaminated areas which require removal of unsound concrete will be identified and marked by the Engineer. The unsound concrete shall be removed by chipping to sound concrete. The marking by the Engineer in the field does not guarantee that unsound concrete is not present in areas beyond those marked. Additional concrete removal may be required after the Contractor's initial removal. The Engineer will review the removal areas prior to concrete replacement.
- D. Where possible, the areas removed shall be rectangular in shape in plan view. Do not feather edges, but chip edges square or slightly undercut.
- E. During the chipping process in deteriorated concrete areas, care shall be exercised to avoid cracking of the underlying sound concrete.
- F. The newly exposed sound concrete shall be cleaned by blowing away loose material with a deep sandblast and followed by cleaning with a compressed air jet.
- G. The Engineer shall be allowed 24 hours for the inspection of properly prepared concrete surfaces and reinforcement, before the scheduled concrete placement.

### 3.2 SURFACE PREPARATION

- A. Concrete surface of existing concrete slab shall be properly cleaned and prepared for new coating system, expansion joint system, and/or header material, per expansion joint system manufacturer's recommendations, which may include but are not necessarily limited to using a shotblast machine to remove laitance followed by cleaning with a compressed air jet or work by both a scabblor or scarifier and a shotblast machine to obtain a proper surface for application of the expansion joint system and associated header materials.
- B. Equipment shall be operated and maintained in accordance with manufacturer's recommendations.
- C. Areas inaccessible to the shotblast machine shall be prepared by sandblasting.

### 3.3 CLEAN UP

- A. Contractor shall remove all loose concrete and other debris and place in appropriate collection location to leave the area free of accumulated waste and broom clean. Cleanup shall be done on a daily basis as a minimum.
- B. Debris shall not be flushed down the existing drains. Restoration contractor shall provide filtering system capable of removing membrane and concrete debris from entering drain system.
- C. Drains are to be checked daily to be certain that filtering system is functioning correctly. Contractor shall not allow water to flow onto the playing field either from their operation or from storm water ponding on plugged drains.

END OF SECTION



## SECTION 02 41 17

### REMOVAL OF EXISTING CONCRETE AND SURFACE PREPARATION

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- B. The Contractor shall notify the Owner and the Engineer at once in writing of any unit price work that deviates materially from the prescribed basis for bidding and for which an adjustment in Unit Price is desired. The Contractor shall measure and quantify all such deviations, subject to the Engineer's verification, prior to any repair work which might make verification impossible. No adjustments in Unit Prices will be considered unless supporting field measurements are provided, and subject to the Owner's prior approval. Adjustments will only be considered if all repairs of a given type have been measured and all deviations, both plus and minus have been included in the determination of the average deviation from the Unit Price basis.
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## PART 2 – PRODUCTS

### 2.1 EQUIPMENT

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- F. The newly exposed sound concrete shall be cleaned by blowing away loose material with a deep sandblast and followed by cleaning with a compressed air jet.
- G. The Engineer shall be allowed 24 hours for the inspection of properly prepared concrete surfaces and reinforcement, before the scheduled concrete placement.

### 3.2 SURFACE PREPARATION

- A. Concrete surface of existing concrete slab shall be properly cleaned and prepared for new coating system, expansion joint system, and/or header material, per expansion joint system manufacturer's recommendations, which may include but are not necessarily limited to using a shotblast machine to remove laitance followed by cleaning with a compressed air jet or work by both a scabber or scarifier and a shotblast machine to obtain a proper surface for application of the expansion joint system and associated header materials.
- B. Equipment shall be operated and maintained in accordance with manufacturer's recommendations.
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- B. Debris shall not be flushed down the existing drains. Restoration contractor shall provide filtering system capable of removing membrane and concrete debris from entering drain system.
- C. Drains are to be checked daily to be certain that filtering system is functioning correctly. Contractor shall not allow water to flow onto the playing field either from their operation or from storm water ponding on plugged drains.

END OF SECTION

SECTION 03 30 00  
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 WORK INCLUDED

- A. Include materials, labor, services, and incidentals necessary for completion of this section of Work.
- B. Extent of cast-in-place concrete work is shown on Drawings.
- C. Include formwork for cast-in-place concrete as required.
- D. Include formwork for concrete bases for equipment of mechanical and electrical divisions. Contractors for those divisions of Work shall be responsible for size, location and required inserts.
- E. Include fabrication and placement of reinforcement for cast-in-place concrete including bars, welded wire fabric, ties, dowels, stirrups, supports and accessories required.
- F. Notify other trades of the date for concrete placement in ample time for each to install their own work.
- G. Inserts, sleeves and other miscellaneous embedded items required by mechanical, electrical or plumbing trades shall be supplied and installed by those respective trades. Provide and install inserts, sleeves and other miscellaneous embedded items other than those required by mechanical, electrical or plumbing trades.
- H. Install anchor bolts, embedded plates, inserts and similar items furnished by other trades.
- I. Supply, install and maintain shoring and re-shoring related to concrete formwork.

1.3 NOTIFICATION

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

1.4 PROTECTION OF ADJACENT WORK

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

## 1.5 QUALITY ASSURANCES

- A. Industry Standards, Specifications and Codes:
  - 1. General:
    - a. Comply with provisions of the following codes and standards except as modified herein.
    - b. Referenced codes and standards including revisions and commentaries shall be the most currently adopted as of the date of these Contract Documents.
  - 2. American Concrete Institute (ACI):
    - a. ACI 117 Standard Specifications for Tolerances for Concrete Construction and Materials
    - b. ACI 301 Specifications for Structural Concrete
    - c. ACI 315 Details and Detailing of Concrete Reinforcement
    - d. ACI 318 Building Code Requirements for Structural Concrete
    - e. ACI 347 Guide to Formwork of Concrete
    - f. Additional ACI sections are noted in later text.
  - 3. National Forest Products Association (NFPA):
    - a. NDS– National Design Specification for Wood Construction including Values for Wood Construction
  - 4. The Engineered Wood Association (APA):
    - a. Plywood Design Specification
  - 5. American Society For Testing And Materials (ASTM):
    - a. Specific ASTM standards are noted in later text.
  - 6. Concrete Reinforcing Steel Institute (CRSI):
    - a. Manual of Standard Practice
    - b. Recommended Practice for Placing Reinforcing Bars

## 1.6 DESIGN CRITERIA

- A. Design forms, shores and bracing. Include factors pertaining to safety of formwork structure such as live load, dead load, weight of equipment on formwork, concrete mix, height of concrete drop, vibration reactions and similar factors.
- B. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.

## 1.7 ALLOWABLE TOLERANCES

- A. Formwork:
  - 1. Flatwork true to plane: 1/4 inch in 10 feet.
  - 2. Vertical surfaces true to plane: 1/4 inch floor to floor.
  - 3. Formwork displacement: Maximum 1/4 inch.
  - 4. Deviation of building dimensions indicated on drawings and position of columns, walls and partitions: 1/4 inch
  - 5. Deviation in cross sectional dimensions of columns, piers or beams or in thickness of slabs and walls: Plus/minus 1/4 inch.
- B. Flatwork tolerance for random-traffic floors should be measured in accordance with ASTM E 1155.
- C. 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.
- D. Floor tolerance measurements shall be made within 16 hours after completion of final troweling operation, and where applicable, before removal of supporting shores.
- E. Floor slabs shall conform to the following ACI F-number requirements:
  - 1. Slab-On-Grade and Level Suspended Slabs Shored Until After Testing:
    - a. Specified Overall Values - FF30/FL20
    - b. Minimum Local Values - FF15/FL10
  - 2. Unlevel Shored Suspended Slabs and Unshored Suspended Slabs:
    - a. Specified Overall Value - FF25
    - b. Minimum Local Value - FF15
- F. See ACI 117 for other tolerances not stated herein.

## 1.8 QUALIFICATIONS

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

## 1.9 SUBMITTALS

- A. Submit in accordance with Division 01 requirements.
- B. Reinforcing Steel Properties: Submit certification of grade, chemical analysis and tensile properties of steel furnished if requested.
- C. Reinforcing Shop Drawings:
  - 1. Show sizes and dimensions for fabrication and placing of reinforcing steel and bar supports.
  - 2. Show type, size and location of accessories.
  - 3. Indicate bar schedules, stirrup spacing and diagrams of bent bars, arrangements and assemblies.
  - 4. Indicate yield strength of bars being provided.
  - 5. Show required bar laps and call out specific lap dimensions.
  - 6. Lap splices shall develop the full strength of the bar unless lesser laps are permitted by the Drawings.
- D. Reinforcing Manufacturer's Literature: Submit manufacturer's specifications, capacities and installation instructions for splice devices.
- E. Mix Designs:
  - 1. Prepare design mixtures for each class of concrete on the basis of laboratory trial mixtures or field test data, or both in accordance with ACI 301. Design mixtures shall meet the requirements listed in Table 33000-1. Submit material content per cubic yard of each class of concrete furnished including:
    - 2. Weight of cementitious materials.
    - 3. Saturated surface-dried weights of fine and coarse aggregates.
    - 4. Quantities, type and name of admixtures.
    - 5. Weight of mixing water.
- F. Submit to Engineer mix designs, certification that materials used in concrete mixtures meet ASTM and other applicable specifications, and documentation indicating proposed concrete proportions will produce an average compressive strength equal to or greater than the required compressive strength as specified in ACI 301. Obtain approval prior to placing concrete.
- G. Test Reports:
  - 1. Submit reports of concrete testing including, compressive strength, density (unit weight), air content, temperature and slump. Furnish copies to General Contractor, Consulting Engineer, Concrete Supplier and Owner. Test results shall be reported in writing within 2 days that tests are made.



## PART 2 - PRODUCTS

### 2.1 MATERIALS

#### A. Hydraulic Cement:

1. For normal concrete, hydraulic cement shall meet requirements of ASTM C 150, ASTM C 595, or ASTM C 1157.
2. For air-entrained concrete, cement shall meet requirements of ASTM C 150, Type 1A Portland Cement or cement specified for normal concrete may be used with an air-entraining admixture conforming to ASTM C 260.

#### B. Fly Ash:

1. Fly ash shall meet the requirements of ASTM C 618.

#### C. Aggregates:

1. Normal weight aggregate shall comply with requirements of ASTM C 33. Lightweight aggregates shall comply with requirements of ASTM C 330.

#### D. Water:

1. Water for batching concrete shall meet the requirements of ASTM C 1602.

#### E. Reinforcing Bars:

1. Conform to ASTM A-615 "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement".
2. Bars shall be deformed, except that plain bars may be used for spirals.
3. Main reinforcing bars and other bars not listed above shall be Grade 60, unless noted otherwise on Contract Documents.

#### F. Welded Wire Fabric:

1. Conform to ASTM A-185 "Standard Specification for Welded Steel Wire Fabric, Plain for Concrete Reinforcement".
2. Welded wire fabric shall be electrically welded and 65,000 psi yield strength.

### 2.2 ADMIXTURES

#### A. No other admixtures will be allowed without Engineer's approval.

#### B. Air-Entraining:

1. Shall Conform to ASTM C 260, certified by the manufacturer to be compatible with other required admixtures. The Entrained air content shall be controlled at 6½ percent for ¾" aggregate concrete and 5½ percent for 1½" aggregate concrete within limits of plus or minus 1½ percent each.

2. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Darex II" – W.R. Grace
    - b. "AEA 92S" - Euclid
    - c. "MasterAir" Series – BASF Admixtures, Inc.
- C. Water Reducing:
1. Shall conform to ASTM C 494, Type A
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. "WRDA 82" – W.R. Grace
    - b. "Eucon WR-91" - Euclid
    - c. "MasterPozzolith 200" – BASF Admixtures, Inc.
- D. Mid-Range Water Reducing:
1. Shall conform to ASTM C 494, Type A or Type F
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Daracem 65" – W.R. Grace
    - b. "Eucon MR" - Euclid
    - c. "MasterPolyheed 997" - BASF Admixtures, Inc.
- E. High-Range Water Reducing (Super Plasticizer):
1. Shall conform to ASTM C 494, Type F or Type G.
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Daracem 19" - W.R. Grace & Co.
    - b. "ADVA 100" - W.R. Grace & Co.
    - c. "Eucon 37" - Euclid
    - d. "MasterRheobuild 1000" - BASF Admixtures, Inc.
- F. Water Reducing, Non-Chloride Accelerator:
1. Shall conform to ASTM C 494, Type C or Type E.
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Polarset" - W.R. Grace & Co.
    - b. "Accelguard 80" - Euclid Chemical Co.

- c. "MasterSet FP 20" - BASF Admixtures, Inc.
- G. Water Reducing, Retarding:
  - 1. Shall conform to ASTM C 494, Type D.
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Daratar 17" - W.R. Grace & Co.
    - b. "Eucon Retarder 100" - Euclid Chemical Co.
    - c. "MasterSet R" - BASF Admixtures, Inc.

## 2.3 BONDING AGENT

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

## 2.4 FORM MATERIALS

- A. General: Plywood, metal-framed plywood-faced or other acceptable panel type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practical sizes to minimize number of joints. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
- B. Formed Surfaces Exposed To View: New plywood complying with U.S. Standard PS-1 Plyform Class I, B-B Concrete Form Plywood, B-Matte MDO Plywood by Simpson, 5/8 inch or 3/4 inch thick without defects, mill oiled and edge sealed or wood forms lined with 3/16 inch tempered pressed wood or 1/4 inch thick plywood B-B conforming to EXT-DFPA as large a size as possible to minimize joints.
- C. Formed Surfaces Concealed From View: Clean straight lumber dressed on face and edges, nominal 1 inch thickness or plywood 5/8 inch or 3/4 inch thick conforming to EXT-DFPA or metal forms smooth and as large a size as possible.
- D. Reveals and Chamfers: Wood or purpose-made plastic or high density plastic foam to achieve sharp, true lines.
- E. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sizes as required of sufficient strength and character to maintain formwork in place while placing concrete.
- F. Form Ties:
  - 1. For Unexposed Concrete: Adjustable length removable or snap-off type which will leave holes no larger than 1 inch in diameter in face of concrete

and when forms are removed no metal will be within 1 inch of finished concrete surface.

2. For Exposed Concrete: Ties shall be snap-off type (break point 1 inch or more from surface) with plastic cones added to form a 1-1/4 inch diameter, 1-1/2 inch deep recess around tie, which shall be grouted flush to match adjacent concrete surface.
  3. No wire ties or site fabricated ties permitted.
- G. Form coatings: For exposed concrete shall consist of an approved non-staining form oil, lacquer or plastic. Plywood approved for reuse shall be recoated as directed by Engineer. When oil is used, excess shall be wiped off with rags. When lacquer is used, a light coating of form oil over lacquer will be permitted provided excess is wiped off. When factory-applied plastic coatings are used, follow manufacturer's instructions. Contact surface of forms shall be free of foreign matter, including dust. Form oil shall be applied to forms before reinforcing is erected. Form oil shall be of type which will not affect bonding of specified exterior finish.
- H. Construction Joint Materials: Solid Wood Lumber, Spruce-Pin-Fir (SPF) #2 or equivalent.

## 2.5 RELATED MATERIALS

- A. Evaporation Retardant and Finishing Aid: Shall be "Confilm" by BASF Admixtures, Inc.
- B. Stair Nosings: Provide single component safety tread stair nosings, Type 231 on interior and exterior stairs, as manufactured by Wooster Products, Inc., Wooster, Ohio, Style AXPE by Safe-T-Metal Company or approved equal, unless indicated otherwise on Project Drawings.
- C. Waterstops: Provide flat, dumbbell type or center bulb PVC type waterstops at construction joints and other joints as indicated or otherwise detailed on Drawings. Size to suit joints. Waterstops shall be a minimum of 6 inches wide and suitable for use intended. Splices shall be made with hot splicing iron recommended by manufacturer and shall conform to Corp or Engineers CRD-C 572.
1. Products: Subject to compliance with requirements, provide products of one of the following:
    - a. AFCO Products
    - b. The Burke Co.
    - c. Edoco Technical Products
    - d. Greenstreak Plastic Products
    - e. Harbor Town Products
    - f. W.R. Meadows
    - g. Vinylex Corp.

- D. Supports for Reinforcement:
1. Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place.
  2. Use wire bar type supports complying with CRSI recommendations unless otherwise indicated. Do not use wood, brick and other unacceptable materials, e.g., mortar blocks, coarse aggregates.
  3. Where indicated on Drawings, slab on grade reinforcement shall be supported on individual high chairs with sand plates for soil bearing (HCP).
- E. Vapor Retarder: Provide over prepared base course. Provide manufacturer's recommended pipe boots, mastics and gusset tape. Use only materials resistant to decay when tested in accordance with ASTM E 154, as follows:
1. Vapor Retarder membrane must have the following qualities;
    - a. Maximum Permeance           ASTM E 960.04 Perms
    - b. Water Vapor Retarder        ASTM E 1745 Meet or exceed Class C
    - c. Thickness of Retarder (plastic)           Not less than 10 mils
  2. Provide one of the following:
    - a. Stego Wrap (10 mil) Vapor Barrier by Stego Industries LLC
    - b. Griffolyn T-85 by Reef Industries
    - c. Moistop Ultra by Fortifiber Industries
- F. Non-Shrink Grout: Factory pre-mixed non-metallic grout, complying with ASTM C 1107.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Set Grout" - ChemRex
    - b. "Sonogrout" - Sonneborn
    - c. "Euco-NS" - Euclid Chemical Co.
    - d. "Sealtight 588" - W.R. Meadows
    - e. "Crystex" - L&M Cons. Chemical Co.
    - f. "Sure-Grip Grout" - Dayton Superior Corp.
    - g. "Horngrout" - A.C. Horn
    - h. "Five Star Grout" - US Grout Corp.
- G. Absorptive Cover: Burlap cloth made from jute or Kenaf, weighing approximately 9 ounces per square yard, complying with AASHTO M182, Class 2.

- H. Moisture-Retaining Cover: One of the following, complying with ASTM C 171, Type 1 or 2:
1. Polyethylene Film
  2. Polyethylene Coated Burlap
- I. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound complying with ASTM C 1315 "Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete", Type I, Class A unless other type acceptable to Architect. Moisture loss not more than 0.040 gr./square cm. In 72 hours when applied at 300 sq. ft./gal. Material must be compatible with resilient flooring and carpeting adhesives. Concrete contractor shall verify compatibility before applying curing compound.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Masterseal" - Master Builders
    - b. "Kure-N-Seal" - Sonneborn
    - c. "Tri-Kote 18 Clear CRECT" - TK Products, Inc.
    - d. "Cure and Seal" - Symons Corp.
- J. Epoxy Adhesive: ASTM C 881, 2 component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Concresive LPL Liquid" - ChemRex
    - b. "Epoxtite" - A.C. Horn
    - c. "Edoco 2118 Epoxy Adhesive" - Edoco Technical Prod.
    - d. "Sikadur Hi-Mod" - Sika Chemical
    - e. "Euco Epoxy 452" - Euclid Chemical Co.
    - f. "Patch and Bond Epoxy" - The Burke Co.
    - g. "Sure-Poxy" - Kaufman Products, Inc.
- K. Sealer: Where concrete floors, new or existing call for "Sealer" in Room Finish Schedule, the following material shall be applied by licensed applicator. Furnish 5 year written guarantee.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Armorseal Floor-Plex 7100, a 2-part water-based epoxy floor coating, manufactured by the Sherwin Williams Company, or approved substitute.

- L. Non-slip Aggregate Finish: For stairs, landings, platforms and where otherwise noted, provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for non-slip finish with emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rust-proof, and non-glassing, and is unaffected by freezing, moisture, and cleaning materials. Submit samples for Architect's approval.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. "Frictex" - Sonneborn
    - b. "Euco-Non-Slip" - Euclid Chemical Co.
- M. Isolation Joint Filler: Shall be bituminous (1/2 inch and 1/4 inch thicknesses) conforming to ASTM D 994.
- N. Control Joint Insert: Shall be hardboard or fiberboard.
- O. Expansion Joint Filler: Shall be extruded polystyrene.

## 2.6 READY MIXED CONCRETE

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

- h. Time loaded or of first mixing of cement and aggregates
  - i. Type, name and amount of admixture
  - j. Type, brand and amount of cement
  - k. Total water content by producer (or W/C ratio)
  - l. Maximum size of aggregate
  - m. Weights of fine and course aggregates
- E. Mix Proportioning:
1. Minimum amount of cementitious material identified in the following mix proportions shall apply for mixes for which field experience or trial mixture information required is not provided.

Table 33000-1

<u>Class</u>	<u>Type of Construction</u>	<u>Specified Comp Strength @ 28 Days (PSI)</u>	<u>Max. Agg. Size (In.)</u>	<u>Air Min. Lbs. of Cement Per C.Y.</u>	<u>Entrainment % +/- 1/2%</u>	<u>Notes</u>
0	Exterior Slab on Grade	4500	0.75	564	6	(1)(2)(4)
1	All Footings	3000	1.5	470	None	(5)
2	Walls/Piers	4000	0.75	494	None	(5)
3	Interior Slab on Grade	4000	0.75	540	None	(3)(5)
4	Bond Beams	3000	0.375	470	None	(5)
5	Precast Topping	4000	0.75	540	None	(5)
6	Miscellaneous Non-Scheduled Concrete Work	3000	0.75	470	6.0	(1)(4)



Notes:

- (1) Air entrained concrete: Use for exterior walls, exterior slabs, walks, platforms, ramps, steps, portions of parking ramp and other concrete exposed to freezing and thawing.
- (2) Maximum water-cementitious ratio by weight shall be 0.45.
- (3) Maximum water-cementitious ratio by weight shall be 0.50.
- (4) 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.
- (5) 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.

### PART 3 - EXECUTION

#### 3.1 GENERAL

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

#### 3.2 PREPARATION

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

#### 3.3 COORDINATION

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

#### 3.4 FORMWORK ERECTION

- A. Erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position. Form both faces of foundations. Earth forming of footings and vertical surfaces of concrete work is not permitted.
- B. Construct forms to sizes, shapes, lines and dimensions shown on Drawings and to obtain accurate alignment, location and grades. Level and plumb work. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets,

chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

- C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crust plates or wrecking plates where stripping may damage concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses and like to prevent swelling and for easy removal.
- D. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- E. At all exposed corners of concrete walls, beams, columns, slab edges and miscellaneous items not specified or indicated, provide 3/4 inch, 45 degree chamfer.
- F. Install ties so portion remaining within concrete after removal is at least 1 inch inside concrete. Remove so surrounding concrete is not disfigured and cleanout hole remains to be patched.
- G. Coat contact surfaces of forms with form-coating compound before reinforcement is placed.
- H. Thin form coating compounds only with thinning agent of type and in amount and under conditions of form coating compound manufacturer's directions. Do not allow excess form coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

### 3.5 INSERTS, EMBEDDED PARTS AND OPENINGS

#### A. Plumbing, Heating and Electrical Items:

1. Pre-manufactured items including inserts, sleeves and other embedded items required by mechanical, electrical and plumbing trades shall be supplied, accurately located, and installed by respective trades.
2. Site fabricated box outs for chases, sleeves and other miscellaneous openings for mechanical, electrical and plumbing trades shall be supplied and installed by Formwork Contractor.
3. Location of mechanical, electrical and plumbing inserts, embedded parts, openings and recesses shall be coordinated with respective trades by General Contractor.

#### B. Other Items:

1. Other inserts, embedded parts, box outs for openings, chases, reveals and recesses except those specifically mentioned above by mechanical, electrical or plumbing trades, shall be installed by Formwork Contractor. Special

inserts, embedded parts or other special requirements needed by specific trades shall be supplied by that respective trade to Formwork Contractor for installation. General Contractor shall have overall responsibility for coordinating location of inserts, embedded parts, openings and recesses.

2. Install concrete accessories in accordance with manufacturer's recommendations; straight, level and plumb. Ensure items are not disturbed during concrete placement.
3. Set and build into Work, anchorage devices and other embedded items required for other work attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached. Build-in dovetail anchor slots vertically.

### 3.6 JOINTS AND EDGE FORMS

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

### 3.7 CLEANING

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

### 3.8 REINFORCING FABRICATION

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

- c. Bars with reduced cross-section due to excessive rusting or other cause.

### 3.9 REINFORCING DELIVERY, STORAGE AND HANDLING

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

### 3.10 REINFORCING INSPECTION

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

### 3.11 REINFORCEMENT PLACEMENT

- A. Comply with specified codes and standards and CRSI "Recommended Practice for Placing Reinforcing Bars" for details and methods of reinforcement placement and supports and as specified.
- B. Clean reinforcement to remove loose rust and mill scale, earth, ice and other materials which reduce or impair bond with concrete.
- C. Position, support and secure reinforcement against displacement by formwork, construction or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers as required.
- D. Place reinforcement to obtain coverages for concrete protection as indicated on Contract Documents. Arrange, space and securely tie bars and bar supports together with 16 gage wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so ends are directly away from exposed concrete surfaces.
- E. At openings in structural slabs, provide two #4 bars top and bottom of slab at 45 degrees on all 4 corners, each bar 48 inch minimum length, unless noted otherwise on the construction documents.
- F. Provide two #3 bars 3 inches apart on 4 sides of floor drains in slabs, unless noted otherwise on the construction documents.
- G. Unless permitted by the Engineer, reinforcing shall not be bent after being embedded in harden concrete.
- H. Suspend footing reinforcement in place with wires to assure proper placement. Where applicable, solid concrete bricks may be utilized to position reinforcement in spread and strip footings.

- I. Welded wire fabric shall lap one full mesh at side and end laps and must be wired together. Mesh for slabs-on-grade shall be raised at least 2 inches during concrete pour. Minimum requirement for concrete toppings and slabs-on-grade shall be WWF 6x6 - W1.4 by W1.4 unless specifically noted otherwise on Drawings.
- J. Provide sufficient number of supports and sizes as required to carry reinforcement. Maximum spacing of chairs is 48 inches on center. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- K. Welding of reinforcement covered by this Section is prohibited.

### 3.12 PLACEMENT OF CONCRETE

#### A. Pre-Placement Inspection:

1. Before placing concrete, inspect and complete formwork installation, reinforcing steel and items to be embedded or cast-in-place. Notify other Contractors to permit installation of their work; cooperate with other trades in setting such work as required. Thoroughly wet wood forms immediately before placing concrete as required where form coatings are not used. Notify inspection agency and Engineer 24 hours in advance of pouring.

#### B. Placing Concrete In Forms:

1. Deposit concrete in forms in horizontal layers not deeper than 18 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints. Maximum length of wall pour is 100 feet between construction joints.
2. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.
3. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use vibrators designed to operate with vibratory element submerged in concrete, maintaining a speed of not less than 6000 impulses per minute. Alternate methods of consolidating concrete including the use of self-consolidating concrete may be submitted to the Engineer for approval.
4. Do not use vibrators to move concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of

reinforcement and other embedded items without causing segregation of mix.

C. Placing Concrete Slabs:

1. Deposit and consolidate concrete slabs in a continuous operation until placing of a panel or section is completed.
2. Place interior slabs on grade using long-strip construction techniques or other approved method.
3. Place suspended slabs in sections as large as practicable to complete finishing, within limits acceptable to Engineer.
4. Consult with Engineer with regard to limits of single placements prior to commencing work.
5. Consolidate concrete during placing operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
6. Bring slab surfaces to correct level with a straightedge and strikeoff. Use bull floats or darbies to smooth surface, leaving it free of humps or hollows. Do not sprinkle water on plastic concrete surface. Do not disturb slab surfaces prior to beginning finishing operations. "Wet Screed" placement of slabs is not allowed.
7. Maintain reinforcing in the proper position during concrete placement operations. mesh shall be lifted to 1/2 slab depth as pouring proceeds.

D. Cold Weather Placing:

1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions or low temperatures in compliance with ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt or other materials containing anti-freeze agents or chemical accelerators other than approved, non-chloride accelerating admixtures.
4. Do not allow carbon dioxide from heating units to contact freshly placed concrete surfaces for 48 hours. Vent heaters outside of enclosure.

E. Hot Weather Placing:

1. When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 301.
2. Wet forms thoroughly before placing concrete.
3. Do not use retarding admixtures without the written permission of the Engineer.

### 3.13 CONCRETE JOINTS

#### A. Construction Joints:

1. Locate as directed by Engineer or as shown on Drawings. Form keyway. Place perpendicular to main reinforcement. Continue reinforcement through joint. Locate joint so as not to affect structural integrity or appearance of the structure. Includes joint between wall and footing.

#### B. Isolation Joints:

1. Form with keyway with bituminous (preformed filler, 1/4 inch or 1/2 inch (as called for) thick full depth of slab-on-grade. Reinforcement is non-continuous. Locate at points of contact between slab-on-grade and vertical structural concrete.

#### C. Control Joints:

1. Locate on grid lines or on lines as shown on Drawings or as directed by Engineer. Joint size shall be 1/4 inch wide by 1/5 to 1/4 of slab depth. Continue reinforcement through joint. Contractor's option to tool or use insert. Do not tool joints in slabs to receive a finished flooring material. Control joints should be made within first 24 hours of concrete pour.

### 3.14 FINISHING

#### A. General:

1. Strike and level concrete. Allow to set before floating. Power float on disappearance of water sheen. Hand float areas inaccessible to power float. Applicable to flat work to obtain smooth, uniform, granular texture. Floors shall be flat and level within tolerances given in Part 1, except where drains occur or sloped floors are indicated, in which case tolerance applies to planes indicated.

#### B. Troweled Finish:

1. Power trowel to smooth finish. Hand trowel areas inaccessible to power trowel. Applicable to flatwork to receive finished flooring material.

#### C. Broom Finish:

1. Draw broom across surface after floating to form a regular, parallel pattern. Applicable to parking ramps, drives, ramps and stairs. Direction of brooming shall be perpendicular to traffic pattern.

#### D. Formed Concrete:

1. Top of concrete: Strike concrete smooth then float and trowel surface to texture comparable to formed surface.
2. Formed Surface: As cast finish, patch holes and defects after form removal. Remove fins.

3. Rubbed Surface: Rub with rubbing stone to remove all projections and round corners. Wet surface and brush evenly with cement grout mixture. Provide rubbed concrete surfaces in finished areas to be left to view in stairwells, where concrete is exposed to view in a finished area and wherever else a rubbed surface is called for on architectural plans.
  4. Slope exterior steps down 1/8 inch.
- E. Exterior Walks:
1. Broom finish unless otherwise indicated. After floating, troweling and when water sheet has disappeared, brush lightly with approved steel or fiber broom not less than 18 inches wide at right angles to centerline to form a uniform roughened surface. Edge panel joints with metal tool to leave smooth border around each panel.
- F. Non-Slip Finish:
1. Apply to exterior concrete stair treads, stair platforms, sloped walks and elsewhere as indicated. After floating, surface shall be given a "dry shake" application of crushed ceramically bonded aluminum oxide. Rate of application of such material shall be not less than 25 pounds per 100 square feet. Tamp aggregate flush with surface using a steel trowel but do not force below surface. After broadcasting and tamping, apply trowel finishing as specified.

### 3.15 CURING

- A. Comply with ACI 301.
- B. Class C Concrete Curing:
1. Concrete surfaces not specified to receive other curing shall be liquid membrane cured per ACI 308 2.3.3. If no rate of coverage is indicated by manufacturer, apply at a uniform rate of 200 square feet per gallon.
- C. Formed Surfaces:
1. Cure formed concrete surfaces including walls, columns, underside of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by membrane curing.
- D. Protection:
1. Protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration and from damage caused by rain or flowing water. Protect finished concrete surfaces from damage by subsequent construction operations.

### 3.16 REPAIRING AND PATCHING

- A. Concrete Surface Repairs:



1. Comply with ACI 301 “Specifications for Structural Concrete”.
2. Remove and replace, at no additional cost, concrete not formed as shown on Drawings, concrete out of alignment, surfaces beyond required tolerances or defective surfaces which cannot be properly repaired or patched, including concrete failing to meet strength requirements as determined by testing laboratory.
3. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to concrete surface. Thoroughly clean, dampen with water and brush coat area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
4. For exposed to view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
5. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar or precast cement cone plugs secured in place with bonding agent.
6. Repair concealed formed surfaces, where possible, that contain defects that affect durability of concrete. If defects cannot be repaired, remove and replace concrete.
7. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope.
8. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, include crazing, cracks in excess of 0.01 inch wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets and other objectionable conditions.
9. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
10. Correct low areas in unformed surfaces during, or immediately after, completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent

concrete. Proprietary leveling compounds may be used when acceptable to Architect.

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

### 3.17 QUALITY CONTROL TESTING DURING CONSTRUCTION

#### A. Formwork:

1. Inspect and check completed formwork, shoring and bracing to ensure work is in accordance with formwork design and supports, fastenings, wedges, ties and parts are secured.
2. Clean and repair surfaces of forms to be reused in Work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact form surfaces as specified for new formwork.
3. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces. Do not use metal cover plates for repairing defects in forms for exposed concrete work.
4. Inform Engineer when formwork is complete and has been cleaned to allow for inspection. Obtain review prior to placing concrete.
5. For exposed to view concrete surfaces do not reuse plywood formwork.
6. Allow Engineer to inspect each section of plywood type formwork prior to reuse.

#### B. Reinforcing:

1. Notify Engineer when reinforcing is in place so he or she may review reinforcing placement. Engineer shall have a minimum of 24 hour notice prior to placement of concrete.
  2. Tend to reinforcing at all times during concrete placement and make necessary adjustments to reinforcing which has been dislodged by concrete placement or workmen.
  3. Bar Placement Tolerances:
    - a. 1/4 inch (plus/minus) between bars.
    - b. 1/4 inch (plus/minus) vertically for members 8 inches deep or less.
    - c. 1/2 inch (plus/minus) vertically for members over 8 inches deep and less than 2 foot deep.
    - d. 1 inch (plus/minus) vertically for members 2 foot or deeper.
- C. General:
1. Sample fresh concrete to conform to ASTM C 172.
- D. Slump:
1. In accordance with ASTM C 143. One slump test at point of discharge from ready mix truck for each set of test cylinders taken, unless noted otherwise, with additional tests when concrete consistency seems to have changed. Slump tests, when taken, shall be conducted after site addition of superplasticizer, however a visual estimate of slump shall be recorded prior to site addition of superplasticizer to a mix. Visual slump should only be used after correlation has been established with actual slump tests. Slump test is intended primarily as a method of comparison for concrete consistency between loads.
- E. Air Content:
1. Only for air entrained concrete, in accordance with ASTM C 231 pressure method for normal weight concrete and ASTM C 173 for lightweight concrete. One air content test for each set of strength test cylinders made unless noted otherwise. If measured air content falls outside limits specified, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, concrete will be considered to have failed to comply with Specifications. In compliance with ASTM C 94, site addition of additional air entrainment admixture is permissible until plant adjustments have been made. For site added superplasticizer, air should only be checked after the addition of superplasticizer.
- F. Concrete Temperature:
1. In accordance with ASTM C 1064 each time a set of compression test specimen is made.
- G. Strength Tests:

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

8. Extent of Testing:
  - a. Class B: Air and slump tests shall be performed at a rate coinciding with strength tests. Test reports shall be sent to A/E immediately upon completion.

H. Formwork Removal:

1. Notify Engineer and Owner's field representative prior to removing formwork, centering, shoring and reshoring.
2. Remove forms in a manner to insure safety of structure at all times. Where entire structure is supported on shores; beam and girder sides, columns and similar vertical forms may be removed after 48 hours, providing concrete is sufficiently hard not to be injured thereby. In no case shall supporting forms or shoring be removed until members have acquired sufficient strength to support their weight and load safely. Coordinate removal with work of other trades.
3. Remove forms according to ACI-347.

END OF SECTION



SECTION 03 31 45  
PATCHING OF STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED WORK

- A. Applicable provisions of Division 01 shall govern work of this Section.
- B. Related work specified elsewhere:
  - 1. Section 02 41 17 - Removal of Existing Concrete and Surface Preparation

1.2 SUMMARY

- A. Include materials, labor, and incidentals necessary for completion of this Section.
- B. Include supplying, placing, finishing, and curing concrete over properly prepared existing concrete surfaces as indicated on Drawings and as specified.
- C. Include replacement concrete for repairs, at topside and underside of slabs, beams, frames, columns, ramps, seating, walls, and other surfaces.

1.3 QUALITY ASSURANCE

- A. Pre-Construction Meeting: A pre-construction meeting is to be required with Contractor in order to coordinate work schedule and inspection required by Engineer.
- B. Contractor shall assume Total Responsibility Guarantee for Material and Labor.
- C. Installer Qualifications: Concrete patching repair work shall be performed under the immediate control of a person experienced in this type of work. The system installer's superintendent assigned to this project shall have a minimum of 5 years experience on projects of similar magnitude and scope and shall be present during system installation.
- D. Inspection: Installer must examine substrate and conditions under which work is to be performed and must notify Contractor in writing of unsatisfactory conditions. Do not proceed with work until unsatisfactory conditions have been corrected.

1.4 SUBMITTALS

- A. Submit manufacturer's product data for concrete repair materials, indicating physical and chemical characteristics, technical specifications, limitations, installation instructions and general recommendations regarding each material.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS

A. Overhead and Vertical Repair Mortar:

1. "SikaRepair SHB" by Sika
2. "HBA" by BASF

Or approved equal. Above products require use of corrosion inhibitor additive such as MCI Grenades by Cortec or approved equal.

3. "Emaco S88 C1" by BASF
4. "SikaTop 123 Plus" by Sika

Or approved equal with corrosion inhibitor

B. Horizontal Repair Mortar:

1. "SikaRepair 222" by Sika
2. "Emaco T430" or "Masterbuilders 10-61" by BASF

Or approved equal. Above products require use of corrosion inhibitor additive such as MCI Grenades by Cortec or approved equal.

3. "MasterEmaco S66 C1" by BASF
4. "SikaTop 111 Plus" by Sika

Or approved equal with corrosion inhibitor.

C. Partial Depth (epoxy sand mortar):

1. "Trafficguard EP35" by BASF
2. "Sikadur 22 Lo-Mod" by Sika

Or approved equal

D. Rebar Coating:

1. "Zincrich Rebar Primer" by Master Builders
2. "Sika Armatec 110 EpoCem" by Sika
3. "Emaco P24" by BASF

Or approved equal specifically designed for application to existing reinforcing steel and inclusion within areas of concrete repair, and compatible with repair mortars specified.

E. Consult with manufacturers for product limitations.



- F. Note that no options have been listed for any of the concrete repair applications permitting the use of “ready-mix” concrete (i.e. delivered by truck from a local batching plant).

### PART 3 - EXECUTION

#### 3.1 PREPARATION OF SURFACES TO RECEIVE PATCHING CONCRETE

- A. Refer to Specification Section 02 41 17 “Removal of Existing Concrete and Surface Preparation for requirements.
- B. Remove unsound material, dirt, oil, grease and other bond-inhibiting materials.
- C. Remove rust and loose concrete on exposed reinforcing steel by sandblasting.
- D. Concrete substrate shall be saturated surface dry with no standing water prior to application and shall be saturated for a minimum of two hours prior to application.
- E. Conform to additional specific preparation requirements specified by manufacturer or ACI Standard for each patching product as applicable.
- F. Cavities will be examined prior to commencement of patching operations. Sounding the surface shall be part of the examination. Delamination noted during the sounding shall be removed as specified.
- G. Airblasting is required as a final step to remove sand and debris. Debris shall be removed from the site prior to the start of patching.
- H. Coat exposed reinforcing steel with rebar primer. Apply per manufacturer’s instructions.

#### 3.2 MIXING, APPLICATION, AND FINISHING

- A. Conform to manufacturer's specifications or ACI Standard for each patching product, as applicable.
- B. Install repair mortar over the patch area and work into the substrate with proper finishing tools.
- C. Finished surface shall be struck off flush with existing surfaces. Finish shall match existing or be lightly brushed.

#### 3.3 CURING

- A. Concrete shall be maintained above 50°F and in a moist condition for at least the first 7 days after placing.
- B. Curing shall be accomplished by burlap covers kept continuously wet, continuous waterproof paper or 4 mil polyethylene sheeting conforming to ASTM C-171 with edges lapped and tightly sealed by sand, wood planks, pressure-sensitive tape, mastic or glue.

- C. For concrete surfaces receiving no overlay a spray applied curing compound may be used in accordance with ASTM C-309. Two applications shall be made; the second shall be within an hour of the first application.
- D. The concrete shall be sounded by the Contractor in the presence of the Engineer with a chain drag after the curing time. Hollowness shall be corrected by the Contractor by removing the concrete at these locations and recasting at no extra cost to the Owner.
- E. Adequate protection shall be provided for concrete during freezing or near freezing weather. Concrete materials, reinforcement, forms, filler and ground with which concrete is to come in contact shall be free of frost, ice and snow. Whenever air temperature is below 40°F, the minimum temperature of concrete when discharged shall be 65°F and concrete during the required curing period shall be maintained at a temperature not less than 50°F. Throughout heating period concrete shall be kept moist as specified. Placement and curing of concrete during cold weather shall conform to requirements of ACI 306R.
- F. Placement and curing of concrete during hot weather shall be in conformance with the requirements of ACI 305R.

END OF SECTION

## SECTION 03 41 13

### PRECAST CONCRETE HOLLOW CORE PLANKS

#### PART 1 - GENERAL

##### 1.1 SCOPE

- A. The work under this section includes the performance criteria, materials, production and erection of precast hollow core plank as shown on the Drawings and specified herein. Included are the following topics:

##### 1.2 WORK INCLUDED

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

##### 1.3 PRODUCTS INSTALLED BUT NOT SUPPLIED

- A. Sizes and locations shall be provided by trade requiring for inclusion on shop drawings. Included, but limited to the following:
  - 1. Electrical boxes, sleeves and embedded hardware provided by Electrical Contractor
  - 2. Frames and sleeves for openings and embedded hardware provided by Mechanical or Plumbing Contractor

3. Installing openings as indicated on the drawings. (Locations and sizes furnished by electrical, mechanical, or plumbing contractors.)

#### 1.4 RELATED WORK

- A. Applicable provisions of Division 01 shall govern work of this section.
  1. Cast in Place Concrete. Refer to Section 03 30 00
  2. Masonry Bearing Walls. Refer to Section 04 20 00
  3. Structural Steel Framing. Refer to section 05 12 00

#### 1.5 REFERENCES

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

4. A-416 Specification for Uncoated Seven-Wire Stress-Relieved Steel Strand for Prestressed Concrete
5. A-496 Specification for Deformed Steel Wire for Concrete Reinforcement
6. A-572 Specification for High-Strength Low-Alloy Columbian-Vanadium Steels of Structural Quality
7. A-615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
8. A-706 Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement
9. C-33 Specification for Concrete Aggregates
10. C-109 Test Method for Compressive Strength, Hydraulic Cement Mortar
11. C-150 Specification for Portland Cement
12. C-171 Specification for Sheet Materials for Curing Concrete
13. C-494 Specification for Chemical Admixtures for Concrete

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

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

### 1.6 SYSTEM DESCRIPTION

#### A. Design Requirements:

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

## 1.7 SUBMITTALS

- A. Submit in accordance with Division 01 requirements
- B. Shop Drawings:
  - 1. Submit shop drawings showing complete information for fabrication and installation of precast concrete units. Indicate member dimensions, weight and cross-section; location, size and type of reinforcement including special reinforcement and lifting devices necessary for handling and erection; locations of anchors, inserts and clips as required; openings and hangers.
  - 2. Erection drawings shall indicate joints to be grouted and any critical grouting sequences.
  - 3. Indicate type, size and thickness of bearing pads to be installed
  - 4. Shop drawings shall clearly indicate members or details at variance from those shown on the contract documents
  - 5. Shop drawings shall indicate loads and reactions precast components and connections transfer to foundations, walls and other supporting structural elements
  - 6. Provide layout, dimensions and identification of each precast unit. Indicate weld connections by AWS standard symbols (Refer to AWS D1.1 and D1.4). Detail inserts, connections and joints including accessories and construction at openings in precast units.
  - 7. Identify handling procedures and methods of transportation for precast members.
  - 8. Indicate estimated camber at time of erection.
  - 9. Indicate fire ratings and live load capacities.
  - 10. Show openings larger than 8 inches. Coordinate size and location of openings required by other trades whether or not openings are shown on Structural Drawings.
- C. Quality Control Submittals:
  - 1. Design Data: Provide manufacturer's complete design calculations prepared by a Structural Engineer registered as a Professional Engineer in the State of Wisconsin.
  - 2. Test Reports: Precast Concrete Contractor shall, at his expense, conduct concrete tests in accordance with PCI MNL-116 consisting of (as a minimum) compression tests of concrete placed at his plant. A/E shall be allowed access to fabrication site to observe placing and testing operations. Copies of tests shall be submitted upon request of A/E.
  - 3. Certificates: Weld operators working on this Job shall possess certificates in accordance with AWS D1.1 and D1.4. Submit certifications no later than

2 weeks prior to the start of erection. Certifications must be dated within 1 year of this same date.

## 1.8 QUALITY ASSURANCE

### A. Manufacturer's Qualifications

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

### B. Erector's Qualifications:

1. Erector shall have at least 5 years of successful experience in erection of precast structural concrete similar to requirements of this Project.
2. Erector shall conform to guidelines presented in PCI MNL-127.
3. Weld operators shall possess valid certifications in accordance with AWS D1.1 prior to construction.

## 1.9 DELIVERY, STORAGE AND HANDLING

### A. Handling and Shipping:

1. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses or damage.
2. Lift or support units only at points shown on erection Shop Drawings.

### B. Storage and Protection:

1. Place non-staining, resilient spacers of even thickness between each unit.
2. Support units during shipment on non-staining, shock-absorbing material.
3. Do not place units on ground.
4. Store units to protect from contact with soil, staining and from physical damage.

5. Store units unless otherwise specified, with non-staining, resilient supports located in same positions as when transported.
  6. Store units on firm, level and smooth surfaces.
  7. Place stored units so that identification marks are discernible.
- C. Acceptance at Site:
1. Conduct inspections, perform testing and make repairs or replace unsatisfactory precast units as required in Specifications.
  2. Patching shall be permitted only as approved by A/E. Mix and place patching mixture to match color and texture of surrounding concrete and to minimize shrinkage. Patching shall be held to a minimum.
  3. In addition to above, in-place precast units may be rejected for any one of the following:
    - a. Exceeding specified installation tolerances.
    - b. Damaged during construction operations.
    - c. Exposed-to-view surfaces which develop surface finish deficiencies.
    - d. Other defects as listed in PCI MNL-116.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

### 2.2 MATERIALS

- A. Concrete:
1. Cement: Shall be Grey Portland conforming to ASTM C-150, Type I.
  2. Fly Ash: Conforming with the following standards;
    - a. ASTM C-311 "Standard Method of Sampling and Testing Flyash and Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete"



- b. ASTM C-618 "Standard Specification for Flyash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete", Class C.
  3. Normal Weight Aggregates: Shall conform to ASTM C-33.
  4. Water: Shall be clean, fresh, free from oil, acid, organic matter or other deleterious substances.
  5. Additional Chemical Admixtures: Shall conform to ASTM C-494.
  6. Curing Materials: Moisture-Retaining Cover shall conform to ASTM C-171, Type 1 or 2.
  7. Liquid Membrane Curing Material shall not be permitted.
  8. Evaporation Retardant and Finishing Aid: "Con-Film" by Master Builders.
  9. Calcium Chloride: Admixtures containing calcium chloride are prohibited.
  10. Sealant: Provide sealant as specified in Section 07 92 00.
- B. Reinforcing Steel:
1. Tensioning Steel Tendons: Shall conform to ASTM A-416 Supplement, Low-Relaxation, 270 KSI minimum ultimate tensile strength.
  2. Deformed Steel Bars: Shall conform to ASTM A-615, Grade 60 for non-welded conditions and ASTM A-706, Grade 60 for welded connections.
  3. Welded Headed Studs: Headed anchors shall be Nelson Type H4L or S3L, flux filled, welded to plates as shown on Drawings. Studs shall be made from cold drawn steel Grades C-1010 through C-1020 per ASTM A-108 and shall be welded per manufacturer's recommendation.
  4. Deformed Bar Anchors: Concrete anchors shall be Nelson, flux filled, deformed bar anchors, Type D2L, welded to plates as shown on Drawings. Studs shall be made from ASTM A-108 cold worked, deformed wire per ASTM A-496 and shall be welded per manufacturer's recommendation.
- C. Steel Connection Plates, Structural Shapes and Headers:
1. Shall conform to ASTM A-6 and A-36 or A-572.
- D. Bearing Strips:
1. Shop Drawings shall identify strip type, size, thickness and location.
  2. Plastic: 1/8 inch thick multi-monomer plastic strips shall be non-leaching and support construction loads with no visible overall expansion. Acceptable type and manufacturers are Korolath by Dayton/Superior Concrete Accessories, Shimmers by JVI
- E. Grout:

1. Shall conform to ASTM C-109. Use 1 part Portland Cement to 3 parts fine sand with water sufficient for placement and hydration.

F. Caulking:

1. Refer to Specification Section 07 92 00.

## 2.3 CONCRETE MIXES

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

## 2.4 FABRICATION

A. Shop Assembly:

1. Fabricate precast hollow core concrete slabs in accordance with PCI MNL-116.
2. Precast concrete slabs shall be wet or steam cured and shall be clean, smooth and straight without fins, broken edges or structural defects prior to delivery.
3. Openings 8 inch in diameter or larger shall be provided by this section.
4. Include cast-in weld plates where required for anchorage or lateral bracing to structural steel members.
5. Cooperate with other trades for installation of items to be cast-in precast hollow core slabs. Notify General Contractor of items not received in ample time so as not to delay work.

B. Shop Finishing:

1. Standard Finish:
  - a. Normal plant run finish produced in forms that impart a smooth finish to concrete.
  - b. Precast units to receive composite topping shall have contact surface sufficiently roughened to develop composite action

## 2.5 SOURCE QUALITY CONTROL

A. Quality-Control Testing:

1. Test and inspect precast concrete according to PCI MNL 116 requirements.
2. Testing:

- a. If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, Precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
- b. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Engineer
- c. Cores will be tested in an air-dry condition or if units will be wet under service conditions, test cores, after immersion in water, in a wet condition.
- d. Strength of concrete for each series of 3 cores will be considered satisfactory if the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no single core is less than 75 percent of the 28-day design compressive strength
- e. Test results will be made in writing on the same day that tests are performed, with copies to Engineer, Contractor, and precast concrete fabricator. Test reports will include the following:
  - 1) Project identification name and number.
  - 2) Date when tests were performed.
  - 3) Name of precast concrete fabricator.
  - 4) Name of concrete testing agency.
  - 5) Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

B. Defective Work:

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

### PART 3 - EXECUTION

#### 3.1 SAFETY

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

#### 3.2 EXAMINATION

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

### 3.3 PREPARATION

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

### 3.4 ERECTION

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

- K. Where slab voids are to be used as electrical raceways or mechanical ducts provide a taped butt joint at end of slabs, making sure the voids are aligned.
- L. Necessary shimming, bolting, welding of weld plates, grouting and calking shall be performed by this Contractor.
- M. Do not cut reinforcing or prestressing steel without written approval of manufacturer and as acceptable to A/E.
- N. Apply sealant uniformly to plank joints on underside of precast concrete units exposed to view.

### 3.5 CONSTRUCTION

#### A. Interface with Other Products:

- 1. Openings less than 8 inches in diameter shall be drilled in the field by trades involved. Openings proposed for field drilling shall be approved in writing by the precast manufacturer prior to drilling operation. Tools used to drill such openings shall be power operated, carborundum or diamond tipped drills approved for use by the precast manufacturer. Damage incurred during drilling operations will be repaired as directed by A/E and paid for by trade involved.
- 2. In no event will drilling be allowed in locations which will endanger capacity of members.
- 3. Unless otherwise shown on the Drawings, items to be fastened to precast members shall be by internally threaded flush mounted drop in expansion anchors (Powers Mini Drop-In or Hilti HDI-P Drop-in Anchor) provided maximum penetration of the anchor is less than 1 inch and anchor locations and use are approved in writing by the precast manufacturer. In no case will use of powder actuated fasteners be allowed.

#### B. Erection Tolerances

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

### 3.6 REPAIR AND RESTORATION

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

### 3.7 FIELD QUALITY CONTROL

#### A. Testing:

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

### 3.8 CLEANING

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

### 3.9 PROTECTION

- A. Installer shall protect members from damage until erected and secured in place. General Contractor shall protect members until acceptance by Owner.
- B. Installer shall be responsible to see that due care is exercised to avoid staining or damaging adjacent finished material during installation of precast units. Contractor, without expense to owner, shall repair and make such damage
- C. Provide non-combustible shields during welding operations.

END OF SECTION

## SECTION 04 90 10

### MASONRY RESTORATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes restoration of stone, brick and terra cotta masonry as follows:
  - 1. Repairing masonry, including replacing damaged units, reconstructing deteriorated areas, and re-pointing existing masonry mortar joints.
- B. Unit Prices: Unit prices for stone, brick and terra cotta masonry restoration and cleaning are specified in Division 1 Section "Unit Prices."

##### 1.2 DEFINITIONS

- A. Masonry Repair: Work completed to masonry to improve the structural, aesthetic and moisture resistance. All repairs shall match the original construction in material, color, size, texture, and method of construction.
- B. Reconstruction: Replacing lost or missing building elements with identical elements to match the original in size, color, texture and method of construction
- C. Mortar Re-pointing: The removal of loose, deteriorated mortar and the replacement of new to meet the structural, aesthetic and moisture resistance properties required for the masonry wall.
- D. Mock-up: A pre-selected area where a representative sample of the Work is completed prior to commencement the entire Work is complete. Mock-ups typically require approvals prior to commencement.
- E. SHPO: State Historic Preservation Officer.

##### 1.3 QUALITY ASSURANCE

- A. Restoration Specialist Qualifications: Engage an experienced, masonry restoration and cleaning firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Implementation of The Secretary of the Interior's Standards for Historic Preservation: Preservation Briefs #1 and #2 is required
  - 1. Restoration Worker Qualifications: Persons who are experienced in restoration work of types they will be performing.
- B. Source Limitations: Obtain each type of material for masonry restoration (face brick, cement, sand, etc.) from one source with resources to provide materials of consistent quality in appearance and physical properties.

- C. Mockups: Prepare mockups of typical repairs, reconstruction and re-pointing as follows to demonstrate aesthetic effects and qualities of materials and execution. Prepare mockups on existing walls under same weather conditions to be expected during remainder of the Work.
  - 1. Repair an area approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide for each type of masonry material indicated to be repaired, re-pointed or replaced.
  - 2. Notify the Architect when ready for formal review by the SHPO. Include the mix specification for the mortar with the communication.

#### 1.4 PROJECT CONDITIONS

- A. Repoint mortar joints and repair masonry only when air temperature is between and 40 and 90 deg F (4 and 32 deg C) and is predicted to remain so for at least 7 days after completion of work.
- B. Cold-Weather Requirements: Comply with the following procedures for masonry repair and mortar-joint pointing:
  - 1. When air temperature is below 40 deg F (4 deg C), heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F (4 and 49 deg C).
  - 2. When mean daily air temperature is below 40 deg F (4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 7 days after repair and pointing.
- C. Hot-Weather Requirements: Protect masonry repair and mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above.
- D. Patch masonry only when air and surface temperatures are between and 55 and 100 deg F (13 and 38 deg C) and are predicted to remain above 55 deg F (13 deg C) for at least 7 days after completion of work. On days when air temperature is predicted to go above 90 deg F (32 deg C), schedule patching work to coincide with time that surface being patched will be in shade or during cooler morning hours.

#### 1.5 SEQUENCING AND SCHEDULING

- A. Order replacement materials at earliest possible date, to avoid delaying completion of the Work.
- B. Order sand for repointing mortar immediately after approval of mockups. Take delivery of and store at Project site a sufficient quantity of sand to complete Project.
- C. Perform masonry restoration work in the following sequence:
  - 1. Remove all existing units to be salvaged for reuse as indicated on the drawings.
  - 2. Repair existing masonry, including replacing existing masonry with new or salvaged masonry materials.



3. Rake out joints that are to be repointed.
4. Inspect for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
5. Point mortar joints.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
  1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
  2. Products: Subject to compliance with requirements, provide one of the products specified.
  3. 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.

### 2.2 MASONRY MATERIALS

- A. Brick Masonry Units.
- B. Provide units with colors, surface texture, size, and shape to match existing clay and with physical properties not less than those determined from preconstruction representative samples of selected existing units.
  - a. For existing work that exhibits a range of colors, provide clay that matches that range rather than brick that matches an individual color within that range.

### 2.3 MORTAR MATERIALS

- A. All mortar materials shall be determined from mortar analysis reports. It shall be the responsibility of the masonry restoration contractor to obtain proper mortar mix analysis for the treatment of historic buildings
- B. Mortar Sand: ASTM C 144, unless otherwise indicated.
  1. Color: Provide natural sand of color necessary to produce required mortar color.
  2. For pointing mortar, provide sand with sharp edges.
  3. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands, if necessary, to achieve suitable match.
- C. Water: Potable.

## 2.4 MORTAR MIXES

- A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
  - 1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not re-temper or use partially hardened material.
- B. Do not use admixtures of any kind in mortar, unless otherwise indicated.

## PART 3 - EXECUTION

### 3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from masonry restoration work.
  - 1. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of restoration and cleaning work.
- B. Prevent mortar from staining face of surrounding masonry and other surfaces.
  - 1. Cover sills, ledges, and projections to protect from mortar droppings.
  - 2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
  - 3. Immediately remove mortar in contact with exposed masonry and other surfaces.
  - 4. Clean mortar splatters from scaffolding at end of each day.

### 3.2 UNIT REMOVAL AND REPLACEMENT

- A. At locations indicated, remove masonry units for salvage and re-installation. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.
- B. Support and protect remaining masonry that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.
- C. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose masonry units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.

1. Remove in an undamaged condition as many whole units as possible by using hand chisels, brushes, and water.
  2. Store brick for reuse, protect existing building elements.
  3. Deliver cleaned salvaged units not required for reuse to Owner, unless otherwise directed.
- D. Clean units surrounding removal areas by removing mortar, dust, and loose particles in preparation for replacement.
- E. Install replacement units into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
- F. Lay replacement units with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.). Use wetting methods that ensure that units are nearly saturated but surface is dry when laid. Maintain joint width for replacement units to match existing joints.
1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing masonry work.
  2. Rake out mortar used for laying masonry units before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing masonry, and at same time as repointing of surrounding area.

### 3.3 REPOINTING MASONRY

- A. Rake out and repoint mortar joints to the following extent:
1. All joints in areas indicated.
- B. Do not rake out and repoint joints where not required.
- C. Rake out joints as follows:
1. Remove mortar from joints to depth of joint width plus 1/8 inch (3 mm), but not less than 1/2 inch (13 mm) or not less than that required to expose sound, unweathered mortar.
  2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
  3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.
    - a. Cut out mortar by hand with chisel and mallet. Do not use power-operated grinders without Architect's written approval based on submission by Contractor of a satisfactory quality-control program and demonstrated ability of operators to use tools without damaging masonry. Quality-control program shall include provisions for supervising performance and preventing damage due to worker fatigue.
    - b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar by hand with chisel and mallet. Strictly adhere to written quality-control program. Quality-control program shall include

provisions for demonstrating ability of operators to use tools without damaging masonry, supervising performance, and preventing damage due to worker fatigue.

- D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.
- E. Point joints as follows:
  - 1. Rinse masonry-joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen masonry-joint surfaces before pointing.
  - 2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
  - 3. After low areas have been filled to same depth as remaining joints, point all joints by placing mortar in layers not greater than 3/8 inch (9 mm). Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing bricks have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar over edges onto exposed masonry surfaces or to featheredge mortar.
  - 4. When mortar is thumbprint hard, tool joints to match original appearance of joints. Remove excess mortar from edge of joint by brushing.
- F. Cure mortar by maintaining in thoroughly damp condition for at least 72 hours including weekends and holidays.
  - 1. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
  - 2. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

### 3.4 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, spray applied at low pressure.
- B. Wash adjacent woodwork and other non-masonry surfaces. Use detergent and soft brushes or cloths.
- C. Clean masonry debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- D. Sweep and rake adjacent pavement and grounds to remove masonry debris. Where necessary, pressure wash surfaces to remove mortar, dust, dirt, and stains.

END OF SECTION

## SECTION 04 20 00

### UNIT MASONRY

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
- B. Applicable provisions of Division I shall govern work of this section.

##### 1.2 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
  - 1. Concrete masonry units.
  - 2. Face Brick.
  - 3. Mortar and grout.
  - 4. Reinforcing steel.
  - 5. Masonry joint reinforcement.
  - 6. Ties and anchors.
  - 7. Embedded flashing.
  - 8. Miscellaneous masonry accessories.
- B. Products installed, but not furnished, under this Section include the following:
  - 1. Hollow-metal frames in unit masonry openings, furnished under Division 8 Section "Steel Doors and Frames."

##### 1.3 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

##### 1.4 PERFORMANCE REQUIREMENTS

- A. Provide masonry assembly that develops the following net-area compressive strength ( $f_m$ ) at 28 days. Determine compressive strength of masonry by testing masonry prisms according to ASTM C 1314.
  - 1. For Concrete Unit Masonry:  $f_m = 2000$  psi (13.8 MPa).

## 1.5 SUBMITTALS

- A. Product Data: For each different masonry unit, accessory, and other manufactured product specified.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

## 1.4 QUALITY ASSURANCE

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
  - 1. Protect Type I concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.6 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.
  - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.

- B. Do not apply uniform floor or roof loads for at least twelve (12) hours and concentrated loads for at least three (3) days after building masonry walls or columns.
  
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed dirt and from mortar splatter by coverings spread on ground and over wall surface.
  - 2. Protect surfaces of window and doorframes, as well as similar products with painted and integral finishes, from mortar droppings.
  - 3. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
  
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
  
- E. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
  - 1. When ambient temperature exceeds 100 deg F (38 deg C), or 90 deg F (32 deg C) with a wind velocity greater than 8 mph (13 km/h), do not spread mortar beds more than 48 inches (1200 mm) ahead of masonry. Set masonry units within one minute of spreading mortar.

## PART 2 - MATERIALS

### 2.1 CONCRETE MASONRY UNITS

- A. General: Provide shapes indicated and as follows:
  - 1. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
  - 2. Provide round-edged units for outside corners.
  
- B. Concrete Masonry Units: ASTM C 90 and as follows:
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa).
  - 2. Weight Classification: Normal weight.
  - 3. Provide Type I, moisture-controlled units.
  - 4. Size (Width): Manufactured to the following dimensions:

a. 8 inches (203 mm) nominal; 7-5/8 inches (194 mm) actual.

5. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

## 2.2. FACE BRICK: ASTM C 216, GRADE SW, TYPE FBX

- A. Unit Compressive Strength: Provide units with minimum average net-area compressive strength to match existing brick.
- B. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30g/194 sq. cm) per minute when tested per ASTM C 67.
- C. Efflorescence: provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
- D. Where shown to "match existing", provide face brick matching color range, texture, and size of existing adjacent brickwork.
- E. Where shown as new construction, provide face brick and thin-brick in similar color range to "match existing" only one degree darker.

## 2.3. MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.
- D. Mortar Cement: ASTM C 1329.
- E. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
- F. Aggregate for Grout: ASTM C 404.
- G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.
- H. Water: Potable.

## 2.4. REINFORCING STEEL

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M; ASTM A 616/A 616M, including Supplement 1; or ASTM A 617/A 617M, Grade 60 (Grade 400).



## 2.5 MASONRY JOINT REINFORCEMENT

- A. General: ASTM A 951 and as follows:
  - 1. Hot-dip galvanized, carbon-steel wire for both interior and exterior walls.
  - 2. Wire Size: W1.7 or 0.148-inch (3.8-mm) diameter.
  - 3. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units where indicated.
- B. For single-wythe masonry, provide truss type with single pair of side rods and cross rods spaced not more than 16 inches (407 mm) o.c.

## 2.6 RIGID ANCHORS

- A. General: Fabricate from steel bars as follows:
  - 1. 1-1/2 inches (38 mm) wide by 1/4 inch (6.4 mm) thick by 24 inches (600 mm) long, with ends turned up 2 inches (50 mm) or with cross pins. U.N.O.
  - 2. Finish: Hot-dip galvanized to comply with ASTM A 153.

## 2.7 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron inserts of type and size indicated.
- B. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:
  - 1. Headed bolts.
  - 2. Nonheaded bolts, bent in manner indicated.
- C. Postinstalled Anchors: Anchors as described below, with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Type: Expansion anchors.
  - 2. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
  - 3. For Postinstalled Anchors in Grouted Masonry Units: Capability to sustain, without failure, a load equal to six times the loads imposed.

## 2.8 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.

- B. Fabricate through-wall flashing with drip edge, unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

- C. Solder and Sealants for Sheet Metal Flashings:

- Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

- Elastomeric Sealant: ASTM C 920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

## 2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Preformed Control-Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

- 1. Styrene-Butadiene-Rubber Compound: ASTM D 2000, Designation M2AA-805.
  - 2. PVC: ASTM D 2287, Type PVC-65406.

## 2.9 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

- 1. Do not use calcium chloride in mortar or grout.
  - 2. Add cold-weather admixture (if used) at the same rate for all mortar, regardless of weather conditions, to ensure that mortar color is consistent.

- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.

- D. Mortar for Unit Masonry: Comply with ASTM C 270 Property Specification.

- 1. Extended-Life Mortar for Unit Masonry: Mortar complying with ASTM C 1142 may be used instead of mortar specified above, at Contractor's option.
  - 2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
  - 3. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement, mortar cement, and lime.
  - 4. For reinforced masonry and where indicated, use Type S.
  - 5. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
  - 6. For interior non-load-bearing partitions, Type O may be used instead of Type N.

- E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143.

## PART III- EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.
- C. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- D. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
  1. Mix units from several pallets or cubes as they are placed.
- E. Wetting of Brick: Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying.

### 3.2 CONSTRUCTION TOLERANCES

- A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:
- B. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.
- C. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), nor 1/2 inch (12 mm) maximum.
- D. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.
- E. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
- F. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).

### 3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
  - 1. Running Bond.
- C. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.
  - D. Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.
  - E. Fill space between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.
  - F. 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.
  - G. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
  - H. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
    - 1. Install compressible filler in joint between top of partition and underside of structure above.

### 3.3 MORTAR BEDDING AND JOINTING

- A. Lay hollow masonry units as follows:
  - 1. With full mortar coverage on horizontal and vertical face shells.
  - 2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
  - 3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.

### 3.4 MASONRY JOINT REINFORCEMENT

- A. General: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
  - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
- B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

- C. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### 3.5 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joints in unit masonry where indicated. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.
- B. Form control joints in concrete masonry as follows:
  - 1. Install preformed control-joint gaskets designed to fit standard sash block.

### 3.6 LINTELS

- A. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.
  - 1. Provide prefabricated or built-in-place masonry lintels. Use specially formed bond beam units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.
- B. Provide minimum bearing of 8 inches (200 mm) at each jamb, unless otherwise indicated.

### 3.7 REINFORCED UNIT MASONRY INSTALLATION

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

### 3.8 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.

- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
  - 3. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.

END OF SECTION

SECTION 05 12 00  
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this section includes labor, materials, equipment and services to provide structural steel framing installation as shown on the Drawings and specified herein.
- B. Structural steel includes elements defined as “Structural Steel” by the AISC “Code of Standard Practice for Steel Buildings and Bridges”.

1.2 REFERENCES

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

6. AWS A5.23/A5.23M:1997 Specification for Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding
- E. Steel Structures Painting Council (SSPC):
1. SSPC-SP 1 Solvent Cleaning
  2. SSPC-SP 2 Hand Tool Cleaning
  3. SSPC-SP 3 Power Tool Cleaning
  4. SSPC-SP 6 Commercial Blast Cleaning
  5. SSPC-SP 10 Near-White Blast Cleaning

### 1.3 SUBMITTALS

- A. Provide submittals in accordance with the requirements of Division 1.
- B. Product Data: prepared for review and approval; include manufacturer's data for each product where specific request is made in Part 2.
- C. Shop Drawings: prepared for review and approval; include erection plans, setting diagrams, erection details showing work required for structural steel framing installation, type of steel, details of structural members including cuts, connections, camber, holes, and other modifications to base member. Indicate type, size and length of bolts, distinguishing between shop and field bolts, and identifying pre-tensioned (PT) and slip-critical (SC) bolts. Indicate welds with standard AWS symbols, distinguishing between shop and field welds, and identifying size, length and type of weld.
- D. Fabricator certifications: prepared for review; include documentation certifying that the structural steel fabricator meets the quality assurance requirements.
- E. Erector certifications: prepared for review; include documentation certifying that the structural steel erector meets the quality assurance requirements.
- F. Mill certifications of structural steel shapes: prepared for review when specifically requested by A/E; show heat number, chemical and mechanical properties and material test results of structural steel delivered to site.
- G. Mill certifications of high strength bolts, nuts and washers: prepared for review when specifically requested by A/E; show chemical and mechanical properties, and bolt test results for fasteners delivered to site.

### 1.4 QUALITY ASSURANCE

- A. Comply with the applicable provisions of the specifications, standards and documents listed under References, except as modified by this specification.
- B. Fabricator: Fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU.



- C. Erector: Erector shall have a minimum of 5 years of continuous experience in the erection of similar structures.
- D. Testing Agency: independent testing laboratory retained by the Owner and continuously engaged in testing similar that required for the Project for a period of not less than five years.
- E. Supervising professional for calculations: a currently licensed Professional Engineer in state in which Project is located.
- F. Welding: Qualify personnel and procedures according to AWS D1.1.

## 1.5 DELIVERY, STORAGE AND HANDLING

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

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Rolled steel plates, shapes and bars, tubular steel and bolts shall be of domestic manufacture and be clean and free of rust and pitting.
- B. W and WT shapes: ASTM A992 ( $F_y = 50$  ksi)
- C. Channels: ASTM A36
- D. Angles: ASTM A36
- E. HSS square and rectangular shapes: ASTM A500 Grade C
- F. HSS round shapes: ASTM A500, Grade C.
- G. Pipe: ASTM A53, Type E or S, Grade B
- H. Plates: ASTM A36
- I. High Strength Bolts: ASTM A325, Type 1 or ASTM A490, Type 1, as detailed
- J. Anchor Bolts: ASTM F1554, Grade 36 unless otherwise noted on plans
- K. Standard Washers: ASTM F436 Type 1

- L. Plate Washers: ASTM A36
- M. Nuts for High Strength Bolts: ASTM A563, Type 1, Grade DH
- N. Nuts for Anchor Bolts: ASTM A563, Type 1
- O. Twist-Off Tension-control Bolt Assemblies: ASTM F1852-05, Type 1, or ASTM F2280-06, Type 1 as detailed.
- P. Threaded Rods: ASTM A36/36M-05
- Q. Welding Electrodes: E70XX
- R. Deformed bar concrete anchors: ASTM A496/496M-05. Acceptable products - D2L as manufactured by TRW Nelson
- S. Primer paint:
  - 1. Acceptable products for interior exposure:
    - a. Series 88HS, Gray, as manufactured by Tnemec Inc.
    - b. Interlac 393, Gray, as manufactured by International Paint Company
    - c. Equal approved rust-inhibitive primer
  - 2. Acceptable products for exterior exposure:
    - a. Series 90-97 Tnemec-Zinc as manufactured by Tnemec Inc.
    - b. Interzinc 52 Zinc-Rich Epoxy Primer, Gray, as manufactured by International Paint Company
- T. Grout for structural steel: Non-shrink, non-metallic, pre-mixed, factory-packaged grout conforming to ASTM C1107/C1107M-07.

## 2.2 DESIGN CRITERIA

- A. Unless noted otherwise, steel to steel framing shall be designed for shear only, and shall use standard framed beam connections (double clip angles) meeting the requirements of the AISC Manual of Steel Construction. Connections shall be symmetrical about the beam web.
- B. Single plate shear tab connections meeting the requirements of the AISC Manual of Steel Construction may be substituted for standard framed beam connections (double clip angles) if and only if one of the following conditions are met:
  - 1. Connection is detailed as a single plate shear tab
  - 2. Connections of beams to one side of a girder are matched by similar connections at similar spacing on the opposite side of the same girder.
- C. Connections shall be designed for reactions shown on drawings. Where no reactions are shown, the connections shall be designed by the fabricator's engineer to support 55 percent (for non-composite beams) of the total uniform load capacity noted in the AISC Manual of Steel Construction for the given member size, span and grade of steel. Multipliers for composite beams are noted on drawings.
- D. Provide a minimum of two 3/4 inch diameter A325 or A490 bolts per connection.

- E. Connection shall be designed as field bolted unless specifically noted otherwise

## 2.3 FABRICATION

### A. GENERAL

1. Fabricate and assemble in shop to the greatest extent possible. Fabricate in accordance with AISC "Code of Standard Practice for Steel Buildings and Bridges"
2. Fabricate items of structural steel according to approved Shop Drawings. Fabrication from Shop Drawings not approved by the Engineer<sup>55</sup> is at the sole risk of the Fabricator.
3. Perform thermal cutting by machine. For cut edges to be welded, comply with AWS D1.1.
4. Combinations of bolts and welds on the same faying surface in the same connection are not permitted unless otherwise detailed.
5. Accurately finish ends of columns and other members transmitting bearing loads.
6. Required straightening of built-up sections shall be performed to minimize residual stresses.
7. Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members as shown on Structural Drawings or approved by Engineer.
8. Complete structural-steel assemblies before starting shop painting operations.
9. Properly mark materials for field assembly.

### B. WELDS

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

### C. BOLTS

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

## 2.4 FINISHES

### A. GALVANIZING

1. Steel designated to be galvanized, except for structural bolts, washers and nuts, shall be hot dip galvanized after fabrication in accordance with ASTM A123/A123M-02.
2. Galvanizing for structural bolts, washers and nuts shall conform to the following:
  - a. Bolts conforming to ASTM A325 and associated washers and nuts shall be hot dip galvanized in accordance with ASTM A153/A153M-05. Nuts shall be lubricated after galvanizing. Bolts, washers and nuts shall be considered a fastener assembly, shall be provided by a single supplier, and shall be shipped together in the same shipping container.
  - b. Bolt assemblies conforming to ASTM F1852-05 shall be mechanically galvanized in accordance with ASTM B695-04. Nuts shall be lubricated after galvanizing.
  - c. Bolts conforming to ASTM A490 and associated washers and nuts, and bolt assemblies conforming to ASTM F2280-06 shall not be galvanized.
3. Galvanize components indicated and components exposed to the exterior whether indicated or not. For the purposes of this paragraph, components providing direct support for exterior cladding shall be considered exposed to the exterior.
4. Fill vent holes and grind smooth after galvanizing. Apply galvanizing repair paint.

### B. PAINTING

1. After inspection and before shipping, clean steel work to be painted to remove oil, grease and similar contaminants complying with SSPC-SP 1. Further cleaning shall be in accordance with paint manufacturer's requirements, but in no case less than the following:
  - a. For interior members not exposed to view use SSPC-SP 2 or SSPC-SP 3
  - b. For interior members exposed to view use SSPC-S10

- c. For exterior members exposed to atmosphere, and for faying surfaces of members at connections designated as slip-critical (SC) use SSPC-SP 6 or SSPC-SP 10
2. Shop paint structural steel except:
  - a. Embedded portion of member further than 2 inches from surface of concrete or mortar in which it is embedded.
  - b. Surfaces of members to receive field applied shear studs, dowel bar anchors, or similar welded attachments.
  - c. Contact surfaces which are to be field welded.
  - d. Faying surfaces of members where a slip-critical connection is required. Protect faying surfaces from overspray during painting operations.
  - e. Members which are scheduled to receive sprayed-on fireproofing.
  - f. Members designated to be galvanized.
3. Apply structural steel primer paint in accordance with manufacturer's instructions, but in no case at a rate less than that which provides a uniform dry film thickness of 2.0 mils to 3.5 mils for interior unexposed steel or 2.5 mils to 3.5 mils for interior exposed and exterior steel.
4. Use painting methods which result in coverage of joints, corners, edges and exposed surfaces. Stripe paint corners, crevices, bolts, welds, and sharp edges. Stripe paint shall set to touch before applying primer coat.

## 2.5 SOURCE QUALITY CONTROL

### A. GENERAL

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

### B. WELDS

1. Verify that welders performing work on the project are qualified according to AWS D1.1 for the welds being performed. Visual inspections shall

include a representative sample of fillet welds, but shall include all full and partial penetration welds.

2. Visually inspect fillet and partial penetration welds for appropriate size, length and location. Perform appropriate non-destructive testing in accordance with AWS D1.1 on welds which appear defective.
3. Perform one of the following inspection procedures on full penetration welds:
  - a. Liquid Penetrant Inspections: ASTM E165
  - b. Magnetic Particle Inspection: ASTM E709. Perform on root pass and on finished weld. Presence of cracks or zones of incomplete fusion or penetration shall be cause for rejection of weld.
  - c. Ultrasonic Inspection: ASTM E164.

#### C. BOLTS

1. Visually inspect connections for proper number, size and type of bolt, and for proper installation of hardened and plate washers. Inspections may be limited to a representative sample of connections for snug tight bolt conditions, but shall include a review of all pre-tensioned (PT) and slip-critical (SC) bolts.
2. For bolted connections, inspection shall be made in accordance with the “Specification for Structural Joints Using ASTM A325 or A490 Bolts”, paragraph 9.1. Where twist-off tension-control bolt assemblies are utilized in bolted connections not specifically identified as pre-tensioned (PT) or slip critical (SC), verify that splines have not been removed. If splines have been removed, bolts shall be removed, discarded, and replaced with properly tightened bolts.
3. For bolts identified as pre-tensioned (PT), inspection shall be made in accordance with the “Specification for Structural Joints Using ASTM A325 or A490 Bolts”, paragraphs 9.1 and 9.2.3. Additional inspection in accordance with paragraph 9.3 shall be made for bolts identified as slip critical (SC).

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 PREPARATION

- A. Provide temporary guy lines to achieve and maintain proper alignment of structure as erection proceeds.

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

### 3.3 ERECTION

#### A. GENERAL

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

#### B. WELDS

- 1. Comply with AWS D1.1 for welding procedures, tolerances, appearance and quality of welds, and for methods used in correcting welding work. Use only welders qualified in accordance with AWS D1.1 and possessing current valid welding certifications for the welds being performed.
- 2. Utilize field welds only where shown. Field welds shall not be used to replace bolted connections in whole or in part.
- 3. Minimum fillet weld size shall be as specified by AISC for the thickness of the thinner part joined, but in no case less than 3/16 inch.
- 4. Perform welding to minimize residual stress and external distortion of welded assembly.
- 5. Provide backing bars and run-off tabs for full penetration field welds.

### C. BOLTS

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

### 3.4 REPAIR / RESTORATION

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

### 3.5 FIELD QUALITY CONTROL

#### A. GENERAL

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



## B. WELDS

1. Verify that welders performing work on the project are qualified according to AWS D1.1 for the welds being performed.
2. Visually inspect fillet and partial penetration welds for appropriate size, length and location. Visual inspections shall include a representative sample of fillet welds, but shall include all full and partial penetration welds. Perform appropriate non-destructive testing in accordance with AWS D1.1 on welds which appear defective.
3. Perform one of the following inspection procedures on full penetration welds:
  - a. Liquid Penetrant Inspections: ASTM E165
  - b. Magnetic Particle Inspection: ASTM E709. Perform on root pass and on finished weld. Presence of cracks or zones of incomplete fusion or penetration shall be cause for rejection of weld.
  - c. Ultrasonic Inspection: ASTM E164.

## C. BOLTS

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

END OF SECTION



SECTION 05 40 00  
COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED WORK

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

1.2 SUMMARY

- A. Include materials, labor, services and incidentals necessary for completion of this Section of Work.
- B. Work includes axially or wind loaded light gauge, cold-formed steel studs, tracks, joists, bridging and related accessories 18 gauge and heavier indicated on Contract Drawings as "steel" studs and specified.
- C. Extent of cold-formed steel framing is shown on Drawings and includes, but is not limited to the following:
1. "C" shaped steel studs for exterior wall systems (18 gauge and heavier).
  2. "C" shaped steel studs for load bearing and non-load bearing wall systems (18 gauge and heavier).
  3. "C" shaped steel joists for floor and roof framing systems.
  4. Fasteners and connectors for framing
- D. Studs listed on drawings are minimum sizes and are to be used only as an aid in bidding. Stud depths shown on drawings are to be used, however flange widths of all cold-formed metal framing shall be determined by the cold-formed framing designer. Stud spacing shall be as determined by the cold-formed framing designer with a maximum permitted spacing of 16" o.c unless noted otherwise on drawing.
- E. Headers and jambs at openings may consist of built-up cold-formed metal sections or hot rolled steel sections (tubes, angles, etc.) as determined by the cold-formed framing designer. Some conditions may necessitate hot-rolled steel sections, and are to be supplied and installed by the cold-formed metal contractor.

1.3 REFERENCES

- A. Industry Standards, Specifications and Codes:
1. General:
    - a. Comply with provisions of the following codes and standards except as modified:
    - b. Referenced codes and standards including revisions and commentaries shall be the most currently adopted as of the date of these Contract Documents.

2. American Iron and Steel Institute (AISI):
  - a. North American Specification for the Design of Cold-Formed Steel Structural Members
  - b. Manual of Cold-Formed Steel Design
  - c. Standard for Cold-formed Steel Framing – Header Design
3. American Welding Society (AWS):
  - a. D1.1 Structural Welding Code - Steel
  - b. D1.3 Specification for Welding Sheet Steel in Structures
  - c. Standard Qualification Procedure
4. American Society for Testing and Materials (ASTM): Specific ASTM numbers are noted in later text.
5. American Institute of Steel Construction (AISC): Manual of Steel Construction

#### 1.4 QUALITY ASSURANCE

- A. Design:
  1. Compute structural properties of studs and joists in accordance with AISI "Specification for the Design of Cold-Formed Steel Structural Members."
- B. Weld Qualifications:
  1. 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 accordance with the Section 6.0 "Inspection" of AWS D1.3.
- C. Inspection And Quality Control:
  1. Contractor shall provide effective full time quality control over fabrication and erection activities.
  2. As directed by Engineer, Owner's testing agency may inspect maintenance of a quality control program, including spot checking weldments and welding procedures in accordance with AWS standards.
  3. Contractor shall remove and replace work, at Contractor's expense, where test results indicate it does not comply with specified requirements. Additional testing and inspection of replaced work shall be a Contractor's expense.
  4. Steel framing manufacturer shall provide a qualified representative for periodic on-site review of fabrication and installation in accordance with manufacturer's recommendations.

5. Inspection by Owner's testing agency is not intended to be comprehensive or complete. Full responsibility for quality control shall remain with Contractor.

## 1.5 SUBMITTALS

- A. Submit in accordance with Division 01
- B. Product Data:
  1. Submit copies of manufacturer's product information and installation instructions for each item of cold- formed steel framing and accessories. Distribute an additional copy of installation instructions to installer.
- C. Shop Drawings:
  1. Submit fabrication and erection Shop Drawings to Engineer prior to fabrication or delivery of material to the site for assemblies, components and installations. Show plans, sections, elevations, and layouts. Indicate material finishes.
  2. Include size, thickness, gauge designations, type, location and spacing of cold-framed members. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, splices, bridging, accessories, type and location of welds, bolts and fastening devices and locations and details as may be required for proper installation.
  3. Show prefabricated framing with individual panel drawings for each condition including configuration, dimensions, materials, attachments and panel locations.
  4. Include shop and field assembly details including cut and connections.
  5. Erection plans shall be stamped by a current Wisconsin Registered Professional Engineer.
- D. Design Calculations:
  1. Submit structural design with supporting calculations stamped by a Registered Professional Engineer in the State of Wisconsin for approval by Engineer.
  2. Design calculations for systems shall include design dead, live, and wind and seismic loads using load criteria as indicated on Drawings. Wind load design shall utilize components and cladding positive and negative wind loads. Include engineering analysis depicting stress and deflection requirements. Include design for connections and attachment to structure.
  3. Limit maximum simple span lateral deflection of studs supporting brick veneer to  $L/720$  with the stud backup system alone taking lateral load. No composite action with sheathing or brick permitted. Limit spandrel panel cantilever projection deflection to  $L/360$  at window head and sill. Limit vertical stud deflection to  $1/8$  inch at window head. Limit maximum simple span lateral deflection of studs supporting metal panels only to  $L/360$ .

4. Design framing systems to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of 1/8 inch, plus or minus of primary building structure.

E. Samples:

1. Submit two 24 inch long samples of each type of stud.
2. Welders shall make sample welds of weld types. Welds shall be inspected by a testing laboratory retained by Owner. Welds shall be approved by lab before production welding begins.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Protect steel 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 the ground in a dry ventilated space or protect from rain and snow or other harmful weather conditions with suitable waterproof coverings adequately vented to avoid condensation.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering "C" shaped, load-bearing and non-load bearing steel studs and joists which may be incorporated in the work include, but are not limited to, the following:
1. Dietrich Industries, Inc.
  2. Marino Industries, Inc.
  3. Clark Western Building Systems, Inc.
  4. Wheeling Corrugating Company
- B. With each type of steel framing required, provide manufacturer's standard steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners and accessories as recommended by manufacturer for application indicated as needed to provide a complete steel framing system.

### 2.2 MATERIALS

- A. "C" Shaped Studs:
1. Manufacturer's standard load-bearing steel studs of size, shape, and gauge indicated on Drawings or minimum:
    - a. 6 inch stud
    - b. 1 5/8 inch flange with flange return lip
    - c. 16 gauge

2. For 16 gauge and heavier units, fabricate steel framing components of structural quality steel sheet with a minimum yield point of 50,000 PSI; ASTM A 1003/ A 1003M.
  3. Provide galvanized finish to steel framing components and accessories in exterior walls complying with ASTM A 653/ A 653 M for minimum G 60 coating.
  4. Runners: Tracks, deep leg tracks and bent plate tracks occurring at top and bottom of steel framing system shall be same gauge as framing.
  5. Provide miscellaneous and special heavy gauge galvanized sheet steel shapes indicated on Drawings.
  6. Finish of installation accessories to match that of main framing components unless noted otherwise.
- B. Welding Electrodes:
1. Shielded metal arc welding shall be made in accordance with the AWS "Specification for Welding Sheet Steel in Structures" and its commentary.
- C. Rolled Steel Plates, Shapes and Bars:
1. Shall meet requirements of ASTM A6/ A 6M and A36/ A 36M for steel with  $F_y = 36$  KSI.
- D. Power- Activated Anchors:
1. Fastener system shall be of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain without failure, a load equal to 10 times design load, as determined by testing per ASTM E1190 conducted by a qualified independent testing agency.
- E. Expansion Anchors:
1. Expansion bolts shall be hot-dipped galvanized. Expansion bolts with the capability to sustain without failure, a load equal to or more than 5 times design load, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.
- F. Other Fasteners:
1. Shall be corrosion-resistant cadmium or zinc plated screws, nuts, bolts, washers and other fasteners.
- G. Sealer Gaskets:
1. Closed cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.
- H. Zinc Rich Paint:
1. Touch up welds with zinc-rich paint in compliance with ASTM A 780.

## 2.3 PROPERTIES

- A. Physical and structural properties listed shall be considered minimum permitted for framing members.

## 2.4 SUBSTITUTIONS

- A. Substitutions must be approved in writing 10 days prior to bid date by Engineer.

## 2.5 FABRICATION

### A. General:

1. Framing components may be prefabricated into panels on or off-site prior to erecting. Fabricate panels plumb, square, true to line and braced against racking with joints welded. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Perform lifting of prefabricated units to prevent damage or distortion.
2. Framing components shall be cut squarely for attachment to perpendicular members or as required for an angular fit against abutting members. Members shall be held positively in place until properly fastened.
3. Fastenings: Attach components by welding, bolting, or screw fastening as standard with manufacturer unless specific method of attachment is noted on Drawings. Wire tying of framing components is not permitted. Welding is permitted on 16 gauge or heavier material only. Where Drawings indicate concentrated loads to be attached to channel by bolting, provide stud reinforcement as required at location of bolted connection.
4. Provide insulation equal to that specified elsewhere in double jamb studs and double header members which will not be accessible to Insulation Contractor.
5. Fabrication tolerances: Fabricate panels to a maximum allowable tolerance variation from plumb, level and true to line of 1/8 inch in 10'-0".

## PART 3 - EXECUTION

### 3.1 INSPECTION AND PREPARATION

#### A. Inspection:

1. Prior to installation, inspect work of other trades. Verify that work is complete and accurate to the point where this installation may properly commence in strict accordance with framing Shop Drawings.

#### B. Discrepancies:

1. Immediately notify Engineer of discrepancies.
2. Do not proceed with installation in areas of discrepancies until such discrepancy has been fully resolved.

### 3.2 INSTALLATION

#### A. General:



1. Install steel framing systems in accordance with manufacturer's printed or written instructions and recommendations and ASTM C1007 unless otherwise indicated.

B. Runner Tracks:

1. Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as required for design loads as noted in design calculations portion of this Specification and as recommended by stud manufacturer for type of construction involved, except do not exceed 24 inches o.c. spacing for nail or power driven fasteners, nor 16 inches o.c. for other types of attachment. Install concrete anchors only after full compressive strength has been achieved. Provide a sill sealer or gasket barrier between concrete and steel connections. Provide fasteners at corners and ends of tracks.
2. Install load bearing shims or grout between underside of wall bottom track or rim track and top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
3. Track shall be securely anchored to supporting structure as shown on fabrication and erection drawings.
4. Track butt joints shall be securely anchored to a common structural element or they shall be butt-welded or spliced together.
5. Install framing members in 1-piece lengths unless splice connections are indicated for track or tension members.
6. Install insulation, specified in Division 07, in built-up exterior framing members such as headers, sills, boxed joints, and multiple studs at openings, that are inaccessible on completion of framing work.
7. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

C. Wall Stud System:

1. Set studs plumb except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
2. Secure studs to top and bottom runner tracks by welding or screw fastening at both inside and outside flanges, except where vertical movement is specified.
3. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of bridging to supporting structure.
4. Framed wall openings shall include headers and supporting studs. Install headers over wall openings wider than stud spacing, including those required for other trades. Locate headers above openings with double stud at each jamb of frame, except where more than 2 studs are either shown or indicated in manufacturer's instructions. Fabricate headers of compound shapes indicated or required to transfer load of supporting studs, complete with clip-

angle connectors, web stiffeners, or gusset plates. Install runner tracks and jack studs 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 to wall opening frame in manner indicated

5. Frame both sides of expansion and control joints as shown for wall systems with a separate stud and do not bridge joint with components of stud system.
6. Install horizontal bridging in stud system, spaced as recommended by manufacturer and at locations required by load-bearing conditions. Weld or mechanically fasten at each intersection.
7. Wall stud bridging shall be attached in a manner to prevent stud rotation. Bridging rows shall be spaced according to manufacturer's recommendation. Without supportive data, minimum bridging shall be 4'-0" on center.
8. Install jack studs or cripples below window sills, above window and door heads, at freestanding stair rails and elsewhere to furnish support, securely attached to supporting members.
9. Temporary bracing shall be provided until erection is completed.
10. Provision for structure vertical movement shall be provided where indicated on Drawings.
11. Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true to line joints. Maximum variation in plane and true position between prefabricated assemblies should not exceed 1/16 inch.

D. Supplementary Framing:

1. Install supplementary framing, blocking and bracing in steel framing system as required by AISI and wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to 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.
2. Install suspended brick panel support as shown on approved Shop Drawings.

E. Field Painting:

1. Touch-up shop applied protective coatings damaged during handling and installation. Use compatible primer for prime coated surfaces; use galvanizing zinc-rich paint for galvanized surfaces. Brush on or spray on paint to a minimum 2 mil dry film thickness.
2. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensures cold-formed framing is without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 06 64 00  
PLASTIC PANELING

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. Plastic sheet paneling.
- B. Related Requirements:
  - 1. Section 05 40 00 "Cold-formed Metal Framing".
  - 2. Section 09 29 01 "Wall Board."

1.3 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.4 QUALITY ASSURANCE

- A. Testing Agency: FM Approvals.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

## 2.2 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319. Panels shall be USDA accepted for incidental food contact.
  - 1. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  - 2. Nominal Thickness: Not less than 3/32 inch.
  - 3. Surface Finish: Molded pebble texture.
  - 4. Color: As selected by Architect from manufacturer's full range.
- B. Acceptable manufacturers:
  - (a) Crane Composites
  - (b) Marlite, A Verzatec Company
  - (c) Duralight Plastics

## 2.3 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
  - 1. Color: As selected by Architect from manufacturer's full range.
- B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
- C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.
- D. Adhesive: Low VOC, as recommended by plastic paneling manufacturer.
- E. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 92 00 "Joint Sealants."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 inches (300 mm) wide.
  - 1. Mark plumb lines on substrate at panel joint locations for accurate installation.
  - 2. Locate panel joints to allow clearance at panel edges according to manufacturer's written instructions.

### 3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.
- D. Install factory-laminated panels using concealed mounting splines in panel joints.
- E. Install trim accessories with adhesive and nails. Do not fasten through panels.
- F. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- G. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- H. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- I. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION



SECTION 07 18 00  
TRAFFIC COATINGS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work under this section includes all labor, material, equipment and related services necessary to install traffic coating.
- B. Extent of work is shown on the Drawings.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. Section includes traffic coatings for pedestrian traffic.
- B. Related work specified elsewhere:
  - 1. Section 02 41 17 – Removal of Existing Concrete and Surface Preparation
  - 2. Section 07 95 01 – Expansion Joint Systems

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. A pre-construction meeting is required with Contractor in order to coordinate work schedule and inspection required by Engineer.

1.5 SUBMITTALS

- A. Product Data: For each type of product, including installation instructions.
- B. Samples for Verification: For each type of exposed finish, prepared on rigid backing.
- C. Provide stepped Samples on backing to illustrate buildup of traffic coatings.
- D. Qualification Data: For Installer.
- E. Product Certificates: For each type of traffic coating.

- F. Field quality-control reports.
- G. Sample Warranty: For warranty.
- H. Maintenance Data: For traffic coatings to include in maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Contractor shall be recognized by the manufacturer of the traffic coating system as an “approved” or “authorized” Contractor applicator of their system and all associated products. Within the past five (5) years, the contractor shall be able to document the successful completion of a minimum of three (3) projects of similar size and scope of the work specified in this section.
- B. Contractor workers employed on this project shall be recognized by the manufacturer of the traffic coating system as an “approved” or “authorized” applicator. Within the past three (3) years, the worker shall be able to document the successful completion of a minimum of one (1) project of similar size and scope.
- C. Mockups: Build mockups to set quality standards for materials and execution.
  - 1. Build mockup for each traffic coating and substrate to receive traffic coatings.
  - 2. Size: 20 sq. ft. of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Adhesion testing shall be performed to insure adhesion to the existing coating and to areas of existing or newly replaced concrete. Adhesion testing shall be approved by coating system manufacturer.

#### 1.7 FIELD CONDITIONS

- A. Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.
- B. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.



- C. Do not install traffic coating until items that penetrate membrane have been installed.

## 1.8 WARRANTY

- A. Provide written “Total System” joint and several warranty in which the manufacturer and installer agrees to replace all components of the traffic coating system that do not comply with performance or other requirements specified in this Section or that fail to remain watertight or free of defects in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following: Adhesive or cohesive failures; Abrasion or tearing failures; Surface crazing or spalling; Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
  - 2. Warranty includes repainting surface markings.
  - 3. Warranty shall include signature of installer and manufacturer.
  - 4. Perform replacement under this warranty at no cost to the Owner.
  - 5. Warranty Period: Five years from date of Substantial Completion.
  - 6. Recommended that Contractor take photos of the finished work for their files and future reference.
- B. Contractor shall perform annual inspections during the term of this guarantee. Schedule annual warranty inspection in coordination with Owner. If Owner alerts Contractor to coating performance issues before the Contractor has conducted the annual inspection for a given year, Contractor shall review such issues on-site within four weeks of receiving notification by the Owner; Contractor may either elect to perform their annual inspection at that time, or may choose to review only the specific issues noted, and return again to complete the annual inspection.

## PART 2 – PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Material Compatibility: Provide primers; base-, intermediate-, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Source Limitations: Obtain primary traffic-coating materials, including primers, from traffic-coating manufacturer. Obtain accessory materials including aggregates, flashings, joint sealants, and substrate repair materials of types and from sources recommended in writing by primary material manufacturer.

## 2.2 TRAFFIC COATING

- A. Traffic Coating: Manufacturer's heavy duty, traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, waterproofing membrane system with integral wearing surface for vehicular and pedestrian traffic; according to ASTM C 957.
- B. At areas of bare concrete and elsewhere noted as full system, systems shall consist of a primer, base coat or membrane, wear coat and top coat. All other areas, system shall consist of a primer wear coat and top coat.
- C. Wear coats are to be saturated with aggregate.
- D. Material thicknesses are wet film thicknesses. Thickness listed for wear coat does not include aggregate.
- E. Traffic coating shall be one of the following systems:

### BASF

Primer: MasterSeal P 220, P 222, or other primer approved by manufacturer  
Base Coat: MasterSeal M 200 (25 wet mils)  
Intermediate coat seeded to refusal: MasterSeal TC 225 (25 wet mils)  
Top Coat: MasterSeal TC 225 (20 wet mils)

### Neogard

Primer: 7760/7761 or other primer approved by manufacturer  
Base Coat: 70410 (25 wet mils)  
Intermediate coat seeded to refusal: 7430 (25 wet mils)  
Top Coat: 7430 (20 wet mils)

### Tremco

Primer: Vulkem 191 Low VOC or other primer approved by manufacturer  
Base Coat: Vulkem 350 NF (25 wet mils)  
Intermediate coat seeded to refusal: Vulkem 345 (25 wet mils)  
Top Coat: Vulkem 346 (20 wet mils)

### Sika

Primer: Sikalstic Primer  
Base Coat: Sikalastic 710 Base (25 wet mils)  
Intermediate coat seeded to refusal: Sikalastic 715 (25 wet mils)  
Top Coat: Sikalastic 715 (20 wet mils)

- F. Color: To match existing coatings within seating bowl.
- G. Aggregate: Manufacturer's standard aggregate of particle sizes, shape, and minimum hardness recommended in writing by traffic-coating manufacturer.

## 2.3 ACCESSORY MATERIALS

- A. Joint Sealants: As specifically recommended by selected coating system manufacturer for their system. Include statement of compatibility with coating system submittal.

Refer to Section 07 92 00 for additional information on adhesion testing, submittals, and warranty requirements related to sealants.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of traffic-coating work.
  - 1. Verify that substrates are visibly dry and free of moisture.
  - 2. Test for moisture according to ASTM D 4263.
- B. Test for moisture content by method recommended in writing by traffic-coating manufacturer.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of traffic-coating work.
- D. Proceed with installation only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.
- E. Begin coating only after minimum concrete-curing and -drying period recommended in writing by traffic-coating manufacturer has passed and after substrates are dry.
- F. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. General: Before applying traffic coatings, clean and prepare substrates according to ASTM C 1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application. Remove projections, fill voids, and seal joints if any, as recommended in writing by traffic-coating manufacturer. Edges of concrete patches shall be ground flush with adjacent concrete surface.
- B. Schedule preparation work so dust and other contaminants from process do not fall on wet, newly coated surfaces.
- C. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.
- D. Remove drain grates prior to coating and reinstall after completion. Do not allow debris to enter drain.

- E. Concrete Substrates: Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D 4259. Do not acid etch.
- F. Remove grease, oil, paints, and other penetrating contaminants from concrete.
- G. Remove concrete fins, ridges, and other projections.
- H. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
- I. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D 4258.

### 3.3 TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written instructions.
- B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.
- C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.

### 3.4 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
- B. Comply with recommendations in ASTM C 1193 for joint-sealant installation.
- C. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic-coating manufacturer.

### 3.5 TRAFFIC-COATING APPLICATION

- A. Apply traffic coating according to ASTM C 1127 and manufacturer's written instructions.
- B. Apply number of coats of specified compositions for each type of traffic coating at locations as indicated on Drawings.
- C. Start traffic-coating application in presence of manufacturer's technical representative.

- D. Verify wet film thickness of each coat complies with requirements every 100 sq. ft.
- E. Uniformly broadcast aggregate on coats specified to receive aggregate. Embed aggregate according to manufacturer's written instructions. After coat dries, sweep away excess aggregate.
- F. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.
- G. Cure traffic coatings. Prevent contamination and damage during application and curing stages.

### 3.6 FIELD QUALITY CONTROL

- A. Final Traffic-Coating Inspection: Arrange for traffic-coating manufacturer's technical personnel to inspect membrane installation on completion.
- B. Notify Engineer 48 hours in advance of date and time of inspection.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

### 3.7 PROTECTING AND CLEANING

- A. Protect traffic coatings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION



## SECTION 07 21 00

### THERMAL INSULATION

#### 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. Polyisocyanurate foam-plastic board.
  - 2. Glass-fiber blanket.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
  - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
  - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

## PART 2 - PRODUCTS

### 2.1 POLYISOCYANURATE FOAM-PLASTIC BOARD

- A. Polyisocyanurate Board, Glass-Fiber-Mat Faced <Insert drawing designation>: ASTM C 1289, glass-fiber-mat faced, Type II, Class 2.
  - 1. Acceptable Manufacturers:
    - (a) GAF
    - (b) Johns Manville
    - (c) Certainteed
  - 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

### 2.2 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
  - 1. Acceptable Manufacturers:
    - (d) GAF
    - (e) Johns Manville
    - (f) Certainteed
- B. Glass-Fiber Blanket, Kraft Faced: ASTM C 665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).
  - 1. Acceptable Manufacturers:
    - (g) GAF
    - (h) Johns Manville
    - (i) Certainteed

### 2.3 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.



1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
  2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

## 2.4 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

### 3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

### 3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

- a. Exterior Walls: Set units with facing placed toward interior of construction.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

### 3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

## SECTION 07 42 13

### FORMED METAL WALL PANELS

#### 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. Exposed-fastener, lap-seam metal wall panels.

##### 1.3 PREINSTALLATION MEETINGS

- Preinstallation Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
  - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
  - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
  - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
  - 7. Review temporary protection requirements for metal panel assembly during and after installation.
  - 8. Review of procedures for repair of metal panels damaged after installation.
  - 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

##### 1.4 SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples: For each type of metal panel indicated with factory-applied finishes.

1. Include Samples of trim and accessories involving color selection.
2. Metal Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal panel accessories.

D. Qualification Data: For Installer.

E. Product Test Reports: For each product, for tests performed by a qualified testing agency.

F. Field quality-control reports.

G. Sample Warranties: For special warranties.

H. Maintenance Data: For metal panels to include in maintenance manuals.

1.5 QUALITY ASSURANCE

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

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical metal panel assembly at agreed upon location, including corner, supports, attachments, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

#### 1.7 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

#### 1.8 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

#### 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal 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 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
- B. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft. (0.3 L/s per sq. m)** when tested according to ASTM E 283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: [**1.57 lbf/sq. ft. (75 Pa)**] [**6.24 lbf/sq. ft. (300 Pa)**].
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: [**2.86 lbf/sq. ft. (137 Pa)**] [**6.24 lbf/sq. ft. (300 Pa)**].
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): [**120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces**] <Insert temperature range>.
- E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

### 2.2 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Mini-Box-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, box-shaped ribs, evenly spaced across panel width, and with rib/recess sides angled more than 60 degrees, ribs at 3 inches on center.
  - 1. Acceptable Manufacturers:
    - (a) McElroy Metal
    - (b) Centria
    - (c) Pac-Clad

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, **G90 (Z275)** coating designation, complying with ASTM A 792/A 792M, **Class AZ50 (Class AZM150)** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
  - a. Thickness: 26 Gauge.
  - b. Exterior Finish: Three-coat fluoropolymer, Kynar.
  - c. Color: As selected by Architect from manufacturer's full range.

### 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, **G90 (Z275 hot-dip galvanized)** coating designation. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
  2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch- (25-mm-)** thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch (13 mm)** wide and **1/8 inch (3 mm)** thick.
  2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
  3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

## 2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

## 2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if



they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Three-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.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
  2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

### 3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Shim or otherwise plumb substrates receiving metal panels.

2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  3. Install screw fasteners in predrilled holes.
  4. Locate and space fastenings in uniform vertical and horizontal alignment.
  5. Install flashing and trim as metal panel work proceeds.
  6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
  2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
  3. Copper Panels: Use copper, stainless-steel, or hardware-bronze fasteners.
  4. Stainless-Steel Panels: Use stainless-steel fasteners.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
  2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
  3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
  4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
  5. Flash and seal panels with weather closures at perimeter of all openings.
- E. Watertight Installation:
1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
  2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
  3. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 feet (3 m)** with no joints allowed within **24 inches (610 mm)** of corner or intersection.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.
- B. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

### 3.5 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION



## SECTION 07 71 00

### ROOF SPECIALTIES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:

- 1. Copings.
- 2. Roof-edge specialties.
- 3. Roof-edge drainage systems.
- 4. Reglets and counterflashings.

- B. Preinstallation Conference: Conduct conference at Project site.

- C. Meet with Owner, Architect, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.

- 1. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
- 2. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

##### 1.3 SUBMITTALS

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

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For roof specialties.

- 1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
- 2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
- 3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
- 4. Detail termination points and assemblies, including fixed points.

5. Include details of special conditions.
- C. Samples: For each type of roof specialty and for each color and texture specified.
1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
  2. Include copings, roof-edge specialties, roof-edge drainage systems, reglets and counter flashings made from 12-inch (300-mm) lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.
  3. Qualification Data: For manufacturer.
  4. Product Certificates: For each type of roof specialty.
  5. Product Test Reports: For copings and roof-edge flashings, for tests performed by a qualified testing agency.
- D. Sample Warranty: For manufacturer's special warranty.

#### 1.4 CLOSEOUT SUBMITTALS

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

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class.
- B. Source Limitations: Obtain roof specialties approved by manufacturer providing roofing-system warranty.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

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

#### 1.7 FIELD CONDITIONS

- A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## 1.8 WARRANTY

- A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 07 18 00 "Traffic Coatings."
- B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer 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 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. FM Approvals' Listing: Manufacture and install copings, roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-60. Identify materials with FM Approvals' markings.
- C. SPRI Wind Design Standard: Manufacture and install copings, roof-edge specialties tested according to SPRI ES-1.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

### 2.2 COPINGS

- A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet (3.6 m), concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.
  - 1. Acceptable Manufacturers:
    - a. Berridge

- b. Metal-Era
  - c. Pac-Clad
2. Metallic-Coated Steel Sheet Coping Caps: Zinc-coated (galvanized) steel, nominal 0.028-inch (0.71-mm) thickness.
- a. Surface: Smooth, flat finish.
  - b. Finish: Three-coat fluoropolymer.
  - c. Color: As selected by Architect from manufacturer's full range.
3. Corners: Factory mitered and continuously welded.
4. Coping-Cap Attachment Method: Snap-on hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.
- a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches (300 mm) wide, with integral cleats.
  - b. Face-Leg Cleats: Concealed, continuous galvanized-steel sheet.

### 2.3 ROOF-EDGE SPECIALTIES

- A. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous metal receiver with integral drip-edge cleat to engage fascia cover. Provide matching corner units.
- 1. Acceptable Manufacturers:
    - a. Berridge
    - b. Metal-Era
    - c. Pac-Clad
  - 2. Metallic-Coated Steel Sheet Fascia Covers: Zinc-coated (galvanized) steel, nominal 0.028-inch (0.71-mm) thickness.
    - a. Surface: Smooth, flat finish.
    - b. Finish: Three-coat fluoropolymer.
    - c. Color: As selected by Architect from manufacturer's full range.
  - 3. Corners: Factory mitered and soldered.
  - 4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
  - 5. Receiver: Manufacturer's standard material and thickness.

### 2.4 ROOF-EDGE DRAINAGE SYSTEMS

- A. Manufacturers:
- 1. Advanced Architectural Sheet Metal and Supply
  - 2. Metal-Era
  - 3. Viking Metal Products
  - 4. Or approved equal
- B. Gutters for 1925 Grandstand Canopy: Manufactured in uniform section lengths not exceeding 10 feet, with matching corner units, ends, outlet tubes, and other accessories. At addition, furnish



flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Zinc-Coated Steel: 24 gauge thickness.
  2. Gutter Profile: Half-round single bead according to SMACNA's "Architectural Sheet Metal Manual."
  3. Corners: Factory mitered and continuously welded.
  4. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
  5. Gutter Accessories: Wire ball downspout strainer, Bullnose ends for half-round gutter.
- C. Downspouts: Plain round complete with smooth-curve elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness.
- D. Parapet Scuppers: Manufactured with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof.
1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness.
- E. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge, and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout, and built-in overflow.
1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness.
- F. Splash Pans: Fabricate from the following exposed metal:
1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness..
- G. Zinc-Coated Steel Finish: Three-coat fluoropolymer.
1. Color: As selected by Architect from manufacturer's full range.

## 2.5 REGLETS AND COUNTERFLASHINGS

- A. Manufacturers:
1. Advanced Architectural Sheet Metal and Supply
  2. Metal-Era
  3. Viking Metal Products
  4. Or approved equal
- B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
1. Zinc-Coated Steel: Nominal 0.022-inch (0.56-mm) thickness.
  2. Corners: Factory mitered and soldered.

3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
  4. Multi-use Type, Embedded: For multiuse embedment in cast-in-place concrete and masonry mortar joints.
- C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets and compress against base flashings with joints lapped, from the following exposed metal:
1. Zinc-Coated Steel: Nominal 0.022-inch (0.56-mm) thickness.
- D. Accessories:
1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
  2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
- E. Zinc-Coated Steel Finish: Three-coat fluoropolymer.
1. Color: As selected by Architect from manufacturer's full range.

## 2.6 MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.

## 2.7 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F (116 deg C).
  2. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F (29 deg C).

## 2.8 MISCELLANEOUS MATERIALS

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
  2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
- B. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

- C. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

## 2.9 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Coil-Coated Galvanized-Steel Sheet Finishes:
  - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A 755/A 755M and coating and resin manufacturers' written instructions.
    - a. Three-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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.
  - 1. Apply continuously under copings, roof-edge specialties and reglets and counterflashings.

2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

### 3.3 INSTALLATION, GENERAL

- A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
  1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  2. Provide uniform, neat seams with minimum exposure of solder and sealant.
  3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
  4. Torch cutting of roof specialties is not permitted.
  5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  1. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
  1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
  2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

### 3.4 COPING INSTALLATION

- A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.
  - 1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

### 3.5 ROOF-EDGE SPECIALITIES INSTALLATION

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

### 3.6 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

- A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches (610 mm) apart. Attach ends with rivets and solder to make watertight. Slope to downspouts.
  - 1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet (15.2 m) apart. Install expansion-joint caps.
- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c.
  - 1. Connect downspouts to underground drainage system indicated.
- D. Parapet Scuppers: Install scuppers through parapet where indicated. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
  - 1. Anchor scupper closure trim flange to exterior wall and seal or solder to scupper.
  - 2. Loosely lock front edge of scupper with conductor head.
  - 3. Seal or solder exterior wall scupper flanges into back of conductor head.
- E. Conductor Heads: Anchor securely to wall with elevation of conductor top edge **1 inch (25 mm)** below scupper discharge.

### 3.7 REGLET AND COUNTERFLASHING INSTALLATION

- A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.
- B. Embedded Reglets: See Section 03 30 00 "Cast-in-Place Concrete" and Section 04 20 00 "Unit Masonry" for installation of reglets.
- C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

### 3.8 CLEANING AND PROTECTION

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

END OF SECTION

## SECTION 07 92 00

### JOINT SEALANTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Include materials, labor, services and incidentals necessary for completion of this Section of Work.
- B. Sealant work for this project includes labor associated with water testing following sealant replacement to show that there are no leaking joints. Following any repair on leaking joints, the Contractor shall continue to water test until there are no more leaks. Contractor is responsible for creating records of water testing, to be certified by the Owner or Owner's authorized representative.
- C. Section Includes: Joint sealants compatible with the selected coating system (refer to Section 07 18 00) meeting requirements indicated herein and as shown on associated plans and details in the drawings.

##### 1.2 PRECONSTRUCTION TESTING

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
- B. Locate test joints where indicated on Project or, if not indicated, as directed by Engineer.
- C. Include separate field adhesion sub-tests for each joint configuration to be encountered (butt joint, corner joint, etc.) based on the project drawings.
- D. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- E. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat for other side.
- F. Notify Engineer seven days in advance of dates and times when test joints will be installed.
- G. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
- H. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained. Documentation of

test results must be certified by manufacturer's technical representative and accepted by Owner before sealant work may begin.

- I. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

### 1.3 SUBMITTALS

- A. Product Data: For each joint sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint Sealant Schedule: Include the following information:
  - 1. Joint sealant application, joint location, and designation.
  - 2. Joint sealant manufacturer and product name.
  - 3. Joint sealant formulation.
  - 4. Joint sealant color.
- D. Qualification Data: For qualified Installer and testing agency (if agency is an independent third party).
- E. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- F. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- H. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing".
- I. Field-Adhesion Test Reports: For each sealant application tested; complete all required Field Adhesion testing necessary to ensure issuance of required warranty by manufacturer upon project completion. .
- J. Warranty: Sample copy of warranty.

### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.



- B. Contractor shall have a minimum of 5 years of experience in performing work similar to that shown in Drawings and Specifications.
- C. Contractor shall submit a list of 5 projects in which similar work to that specified was successfully completed. List shall contain the following for each of the 5 projects:
  - 1. Project name and Owner of project; approximate date of completion
  - 2. Owner's representative, address and telephone number
  - 3. One-sentence description of work and cost of work similar to this project
- D. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- E. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
  - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- F. Preinstallation Conference: Conduct conference at Project site. The installer, Engineer, sealant manufacturer's technical representative and other trades involved in coordination with sealant work shall meet with Contractor at Project Site to review procedures and time schedule proposed for installation of sealants and coordination with other work. Review each major sealant application required on the Project.

#### 1.5 PROJECT CONDITIONS

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

#### 1.6 WARRANTY

- A. The completed installation shall be guaranteed jointly and severally on a single document, by sealant manufacturer and installer agreeing to repair or replace sealants which fail to perform as airtight and watertight joints or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain

resistance or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of material for exposure indicated.

- B. The sealant manufacturer shall submit a detailed warranty consistent with the terms of this specification prior to construction for approval. The approved warranty shall be made part of the contractual agreement and shall represent the sole warranty statement for the project.
- C. The sealant manufacturer and installer shall visit the site at least once a year (for 5 years) to review the condition of the work and to make repairs. This condition review shall be included in the warranty documents.
- D. Perform any repair under this warranty at no cost to the Owner.
- E. Warranty Period: Five years from date of Substantial Completion.
- F. Warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

- D. Colors of Exposed Joint Sealants: As selected by Owner from manufacturer's standard range of colors.

## 2.2 URETHANE JOINT SEALANTS

- A. Sealants as Required for Coating Installation: Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use T.
- B. Products: Subject to compatibility with selected coating system (see Section 07 18 00), provide one of the following:
  1. BASF Building Systems; Sonolastic NP 2.
  2. Sika Corporation, Construction Products Division; Sikaflex - 2c NS.
  3. Tremco Incorporated; THC-900.

Or approved equal (submit documentation of acceptability from coating manufacturer)

## 2.3 JOINT SEALANT BACKING

- A. Backing, General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and as approved in writing by joint sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.4 MISCELLANEOUS MATERIALS

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

## PART 3 – EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Removal of sealant by means of waterblasting is not permitted.
- B. Complete removal of existing sealant is required for installation of new sealants.
- C. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with compressed air. Porous joint substrates include concrete.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include metal.
- D. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- E. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
  - B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
  - C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - D. Do not leave gaps between ends of sealant backings.
  - E. Do not stretch, twist, puncture, or tear sealant backings.
  - F. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
  - G. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
  - H. Install sealants and backings using proven techniques that comply with the following:
    - 1. Place sealants so they directly contact and fully wet joint substrates.
    - 2. Completely fill recesses in each joint configuration.
    - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
  - I. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - J. Remove excess sealant from surfaces adjacent to joints.
  - K. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - L. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
  - M. Use masking tape to protect surfaces adjacent to tooled joints.
- 3.4 FIELD QUALITY CONTROL
- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
  - B. Extent of Testing: Test completed and cured sealant joints as follows (unless more stringent testing is required by sealant manufacturer):

- C. Perform 2 tests for the first 400 feet of joint length for each kind of sealant and joint substrate. Perform 1 test for each 400 feet of joint length thereafter.
- D. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- E. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat for other side.
- F. Inspect tested joints and report on the following:
  - 1. Whether sealants filled joint cavities and are free of voids.
  - 2. Whether sealant dimensions and configurations comply with specified requirements.
  - 3. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
- G. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
- H. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- I. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
- J. Water Test: After completion of each section of sealant work, Contractor shall water test structure and demonstrate to the satisfaction of Engineer and Owner that the structure is waterproofed.
- K. Water test shall be performed by keeping joints continuously wet for 1 hour. Naturally occurring heavy rainstorms with wind directing rain in towards the joints may or may not be acceptable as a substitute for water testing by hose or spray rack; acceptance subject to Engineer review.
- L. Repair leaks observed by review of underside of joints.
- M. Repeat test and repairs until joints are proven to be watertight for a full hour.

### 3.5 CLEANING

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

### 3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION





SECTION 07 95 01  
EXPANSION JOINT SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this section includes all labor, material, equipment and related services necessary to install joint seal systems where shown on the drawings.

1.2 RELATED WORK

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

1.3 SUMMARY

- A. Include materials, labor, services and incidentals necessary for the completion of this section of the work.
- B. The work covered under this section consists of installing the expansion joint seals as shown and detailed on the drawings. Expansion joint blockouts shall also be provided as detailed on the drawings.

1.4 SUBMITTALS

- A. **Manufacturer's Data and Samples:** Submit three copies of manufacturer's specifications, recommendations and installation instructions for each type of material required. Include manufacturer's published data, letter of certification or certified test laboratory report indicating that each material complies with the requirements and is intended generally for the applications shown. Show by transmittal that one copy of each recommendation and instruction has been distributed to the installer. Literature, details, samples, shop drawings, warranties, etc. shall be included in the submittal.
- B. **Warranty:** The system manufacturer shall furnish the Owner with a written single-source performance warranty that the expansion joint system be free of defects related to design, workmanship or material deficiency for a five year period from substantial completion of the work required under this section. The following problems shall be specifically covered under the warranty:
  - 1. Adhesive or cohesive failure of the seal.
  - 2. Discoloration, crazing or other weathering deficiency of the seal.
  - 3. Abrasion or tear failure of the seal resulting from normal traffic use.
  - 4. Defective joint installation.
- C. Provide sample warranty prior to start of work including statement from expansion joint system supplier confirming their technical representatives have reviewed project-specific conditions. Perform repair under this warranty at no cost to the Owner.

- D. The system manufacturer shall submit a detailed warranty consistent with the terms of this specification prior to construction for approval. The approved warranty shall be made part of the contractual agreement and shall represent the sole warranty statement for the project.
- E. Snowplows, abrasive maintenance equipment, and vandalism and are not normal traffic use and are exempt from the warranty. Furnish the Owner with five copies of the snow removal guidelines for the areas covered by this warranty.
- F. Joint Installer Qualification: Expansion joint installer shall submit qualification to Engineer for approval showing 5 years experience and a minimum of 5 locations where the installer has successfully installed the specified joint sealants. Engineer reserves the right to reject installer with insufficient or improper qualifications.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

#### A. General

- 1. Expansion joint seal shall be a complete system of compatible materials designed by the manufacturer to produce waterproof, traffic-bearing seals as detailed on the drawings.
- 2. Expansion joint seal system must conform to Americans with Disabilities Accessibility Guidelines for Buildings and Facilities.
- 3. Style – precompressed foam seal consisting of Cellular polyurethane foam impregnated with hydrophobic 100% acrylic. Precompressed foam seal shall be factory-coated with silicone. Also include, as required: Field-applied epoxy adhesive primer; and field-injected silicone sealant bands.

#### B. Acceptable Products and Manufacturers:

- 1. “DSM System” by Emseal
- 2. “Willseal 250” by Willseal

Or approved equal.

- C. All substitute candidates to be certified by manufacturer in writing to be free in composition of any waxes or asphalts, wax compounds or asphalt compounds.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. The system manufacturer shall review and approve joint layouts, methods of providing joints, concrete finishing and curing methods and related details prior to construction.

- B. Seal system manufacturer shall assume direct contractual responsibility for installation of the seal system.

### 3.2 PREPARATION

- A. The existing joint shall be saw-cut on both sides by the Contractor to create a new joint of the size required. It shall be the responsibility of the Contractor to provide blockouts with clean, sound substrates free of voids in accordance with dimensions detailed in the drawings and per manufacturer's requirements.
- B. Contractor shall be responsible for protecting joint and removal of foreign material which might impair expansion joint performance. Expansion joint contractor shall perform final cleaning and sandblasting or physical abrading of surface. Commencing of work by expansion joint contractor shall constitute acceptance.
- C. A site inspection shall be made by authorized personnel prior to commencing installation of the system for the purpose of reviewing and approving related conditions affecting performance requirements of this specification. Work shall not proceed until unsatisfactory conditions have been corrected in a manner acceptable to the installer, the manufacturer, and the engineer.

### 3.3 INSTALLATION

- A. Work shall not proceed under adverse weather conditions or when temperatures are below or above manufacturer's recommended limitations for installation.
- B. Installation procedures shall be in accordance with the system manufacturer's written instructions.
- C. Joints shall be protected from water immersion (due to rain, snow or other work) during the initial installation.
- D. The expansion joint seal system shall be protected from traffic until completely cured.
- E. Prior to opening to traffic, test joint seal for leaks by keeping seal continuously wet for 2 hours. Repair leaks observed by review of underside of seal. Repeat test and repairs until seal is proven to be watertight for 2 hours.

END OF SECTION



## SECTION 08 11 13

### HOLLOW METAL DOORS AND FRAMES

#### 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. Commercial quality steel doors and frames.

###### B. Related Sections:

- 1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
- 2. Division 08 Section "Door Hardware" for door hardware for hollow metal doors.
- 3. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

##### 1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.
- C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

##### 1.4 SUBMITTALS

- A. Product Data: For each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation of standard steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

1. Schedule: Provide a schedule of doors and frames using same reference numbers for details and openings as those on bid documents.
- C. Label Construction Certification: For door assemblies required to be fire rated and exceeding limitations of labeled assemblies, submit manufacturer's certification that each door and frame assembly has been constructed to conform to design, materials and construction equivalent to requirements for labeled construction.

## 1.5 QUALITY ASSURANCE

- A. Provide doors and frames complying with on of the following:
  1. Steel Door Institute (SDI) "Recommended Specifications Standard Steel Doors and Frames" ANSI/SDI-100 and as herein specified.
  2. Hollow Metal Manufacturers Association (HMMA) "Hollow Metals".
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80, are identical to door and frame assemblies whose fire resistance characteristics have been determined per ASTM E 152 and which are labeled and listed by UL.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage.
- B. Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Architect; otherwise, remove and replace damaged items as directed.
- C. Store hollow metal work under cover at Project site. Place units on minimum 4-inches high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately.
  1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide standard steel doors and frames by one of the following:
  1. Amweld Building Products, LLC.
  2. Ceco Door Products; an Assa Abloy Group company.
  3. Curries Company; an Assa Abloy Group company.
  4. Kewanee Corporation (The).
  5. Pioneer Industries, Inc.

6. Republic Builders Products.
7. Steelcraft; an Ingersoll-Rand company.

## 2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 366, Commercial Quality Carbon Steel (CS).
- B. Supports and Anchors: Fabricate of not less than 16-gage sheet steel, galvanized after fabrication in compliance with ASTM A 153, Class B,
- C. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior wall, hot-dip galvanized according to ASTM A 153, Class C or D as applicable.
- D. Shop Applied Primer: Rust-inhibitive enamel or paint, applied by either air-drying or baking, suitable as a base for specified finish paints complying with ANSI A224.1, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

## 2.3 STANDARD HOLLOW METAL DOORS

- A. General: Fabricate steel doors to be rigid, neat in appearance and free from defects, warp or buckle. Fit and assemble units in factory. Comply with ANSI/SDI-100 requirements.
- B. Provide flush steel doors 1-3/4 inches thick, seamless hollow construction. Bevel vertical edges 1/8 inches in 2 inches.
  1. Fabricate of two stretcher-leveled sheets, minimum 18 gage.
  2. Construct doors with smooth, flush surfaces, without visible joints or seams on exposed faces or stile edges in accordance with ANSI/SDI 100 Grade II, heavy-duty, Model 3 or 4.
  3. Internal Construction: Manufacturer's standard honeycomb, polyurethane, polystyrene, unitized steel grid, vertical steel stiffeners, or rigid mineral fiber core with internal sound deadener on inside of face sheets where appropriate in accordance with SDI standards.
  4. Reinforce tops and bottoms of doors with 18 gage horizontal steel channels, welded continuously to outer sheets.
  5. Clearances: Not more than 1/16 inch at jambs and heads except between non-fire-rated pairs of doors not more than 1/4 inch. Not more than 1/2 inch at bottom.
- C. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

## 2.4 STANDARD HOLLOW METAL FRAMES

- A. Provide metal frames for doors as shown on drawings and schedules.
- B. Knock-down frames are acceptable only in existing masonry wall openings.
- C. Fabricate steel frame units to be rigid, neat in appearance and free from defects, warp or buckle and with all fastenings concealed. Fit and assemble units in factory. Comply with ANSI/SDI-100 requirements.

- D. Fabricate frames of minimum 16-gage cold-rolled steel for openings up to 4'-0" wide and 14-gage for openings over 4'-0" wide.
- E. Fabricate frames of full-welded unit construction, mitered corners, reinforced and continuously welded for full depth and width of frame.
- F. Head Reinforcing:
  - 1. Leave vertical mullions open at top for grouting.
  - 2. For frames over 4'-0" wide, provide continuous steel channel or angle stiffener, 12 gage minimum, for full width of opening and welded to back of frame at head.
- G. Jamb Anchors: Minimum 18 galvanized sheet steel, adjustable, flat, corrugated or perforated, T-shaped to suit frame size. Leg shall be 2 inches wide min. by 10 inches long. Minimum of three per jamb, to be equally spaced.
- H. Spreader Bars: Provide removable spreader bars across bottom of all frames, tack welded to jambs and mullions.

## 2.5 HARDWARE PREPARATION

- A. Prepare doors and frames to receive concealed hardware in accordance with final Door Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 Series Specifications for door and frame preparation for hardware.
- B. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at project site.
- C. Locate hardware as indicated on final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware on Standard Steel Doors and Frames," published by Door and Hardware Institute.
- D. Steel plate reinforcement for finish hardware shall comply with the following minimum requirements:
  - 1. Hinges: 7 gage thick by 1-1/2 inches wide by 6 inches longer than hinge. Secure with no less than six spot welds.
  - 2. Strikes, Flush Bolts, and Closers: 12 gage.
  - 3. Surface-Mounted Hold Open Arms and Panic Devices: 12 gage.
  - 4. All other surface mounted hardware: 16 gage.

## 2.6 STEEL FINISHES

- A. Shop Priming: Clean, treat, and prime paint exposed surfaces of steel door and frame units, including galvanized surfaces.
  - 1. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.
  - 2. Apply pretreatment to cleaned metal surfaces using cold phosphate solution (SSPC-PT2), hot phosphate solution (SSPC-PT4) or basic zinc chromate-vinyl butryl solution (SSPC-PT3).



3. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint of no less than 7 mils dry film thickness.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install standard steel doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and in accordance with SDI or HMMA requirements.
- B. Placing Frames: Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames," or NFPA 80 at fire-rated openings unless otherwise indicated.
  1. Except for frames located at existing concrete or masonry installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
  2. In masonry construction, locate 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb.
  3. At existing concrete or masonry construction, provide 3 completed opening anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb, set frames and secure to adjacent construction with bolts and masonry anchorage devices.
- C. Door Installation: Fit hollow metal doors accurately in frames, with the following clearances:
  1. Jambs and Head: 3/32 inch.
  2. Meeting edges, pairs of doors: 1/8 inch.
  3. Bottom: 3/8 inch with no threshold, 1/8 inch with threshold.
  4. Install fire-rated doors with clearances as specified in NFPA Standard No. 80.

### 3.2 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition.
- B. Prime-Coat Touchup: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

END OF SECTION



## SECTION 08 31 13

### SERVICE DOORS AND FRAMES

#### 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 food service bi-parting swinging doors and frames for food service areas.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.

#### PART 2 - PRODUCTS

##### 2.1 DOORS AND FRAMES

- A. Flush Swinging Service Doors:
  - 1. Acceptable Manufacturers:
    - (a) Curtron Products
    - (b) Eliason Inc.
    - (c) TMI Service
  - 2. Description: Bi-parting, double panel.
  - 3. Door Size: Refer to drawings.
  - 4. Aluminum Sheet for Door: Nominal 0.063 inch, factory anodized.
  - 5. Frame Material: Same material and finish as door, extruded.
  - 6. Latch and Lock: [

- B. Window size: 9 inches x 14 inches standard.
- C. Impact Plates: 48 inches, .093" ABS.
- D. Hardware: Safety hinge assembly and bottom pin. Push plates.

## 2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Frame Anchors: Same material as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

## 2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
  - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
  - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

## 2.4 FINISHES

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

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

### 3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION



## SECTION 08 33 13

### OVERHEAD COILING DOORS

#### 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. Counter doors.

- B. Related Requirements:

- 1. Section 09 21 16 "Non-Structural Metal Framing" for miscellaneous steel supports.
- 2. Section 09 90 00 "Painting and Coatings" for finish painting of factory-primed doors.

##### 1.3 SUBMITTALS

- A. Product Data: For each type and size of coiling counter door and accessory.

- 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
- 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- 3. Include description of automatic closing device and testing and resetting instructions.

- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

- 1. Include plans, elevations, sections, and mounting details.
- 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
- 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
- 4. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
- 5. Include diagrams for power, signal, and control wiring.

- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.
- D. Samples: Color Selection
  1. Include similar Samples of accessories involving color selection.
- E. Qualification Data: For Installer.
- F. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.
- G. Maintenance Data: For coiling counter doors to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
  1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.
  1. Obtain operators and controls from coiling counter door manufacturer.

#### 2.2 COUNTER DOOR ASSEMBLY

1. Acceptable Manufacturers:
  - (a) Overhead Door
  - (b) Clopay Door
  - (c) Cookson Door
- B. Operation Cycles: Door components and operators capable of operating for not less than 10,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
  1. Include tamperproof cycle counter.
- C. Door Curtain Material: Galvanized steel.
- D. Door Curtain Slats: F-158.
  1. Gasket Seal. Manufacturer's standard continuous gaskets between slats.



- E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated hot-dip galvanized steel, primed.
- F. Curtain Jamb Guides: Primed steel with exposed finish matching curtain slats.
- G. Hood: Primed steel.
  - 1. Shape: Square.
  - 2. Mounting: Inside face of wall.
- H. Sill Configuration: No sill.
- I. Locking Devices: Equip door with locking device assembly and chain lock keeper.
- J. Manual Door Operator: Manufacturer's standard crank operator.
  - 1. Provide operator with through-wall shaft operation.
  - 2. Provide operator with manufacturer's standard removable operating arm.
- K. Curtain Accessories: Equip door with weatherseals.
- L. Door Finish:
  - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

## 2.3 MATERIALS, GENERAL

- A. Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate coiling counter-door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
  - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
  - 2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.
  - 1. Jamb Guides: Manufacturer's standard.

## 2.5 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
  - 1. Galvanized Steel: Nominal **0.028-inch- (0.71-mm-)** thick, hot-dip galvanized steel sheet with **G90 (Z275)** zinc coating, complying with ASTM A 653/A 653M.
- B. Integral Frame, Hood, and Fascia: Welded sheet metal assembly of the following sheet metal(s):
  - 1. Galvanized Steel: Hot-dip galvanized steel sheet with **G90 (Z275)** zinc coating, complying with ASTM A 653/A 653M.

## 2.6 CURTAIN ACCESSORIES

- A. Weatherseals: Equip door with weather-stripping gaskets fitted to entire perimeter of door for air-resistant installation unless otherwise indicated.
  - 1. At door head, use **1/8-inch- (3-mm-)** thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
  - 2. At door jambs, use replaceable, adjustable, continuous, [**flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene**] [**nylon brushes**] <Insert material>.

## 2.7 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.8 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Crank Operator: Consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit, of type indicated. Size gears to require not more than 25-lbf (111-N) force to turn crank. Fabricate gearbox to be oil tight and to completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

## 2.9 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

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

## 2.10 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

## 2.11 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

### 3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Perform installation and startup checks according to manufacturer's written instructions.
  - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

### 3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

### 3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.
  - 2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

### 3.7 SCHEDULE

- A. Refer to Drawings.

END OF SECTION

## SECTION 08 71 00

### DOOR HARDWARE

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Hinges.
  - 2. Cylinders and Keys.
  - 3. Locksets.
  - 4. Lever Handles.
  - 5. Closers.
  - 6. Doors Stops.
  - 7. Thresholds and Door Weather Strips.
  - 8. Deadbolts.

- B. Related Sections include the following:
  - 1. Division 08 Section "Hollow Metal Doors and Frames".

##### 1.3 SUBMITTALS

- A. Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- B. Final hardware schedule coordinated with Architect's schedule and related work to ensure proper size, thickness, function, and finish of door hardware. Determine hand from plans.
  - 1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Coordinate with Architect's Door and Hardware schedule in the documents. Include the following information:
    - a. Type, style, function, size, and finish of each hardware item.
    - b. Name and manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of each hardware set cross referenced to Drawings and Schedule.
    - e. Mounting locations for hardware.
  - 2. Submittal Sequence: Submit initial draft of final schedule along with essential product data in order to facilitate the fabrication of other work that is critical in the Project construction schedule. Submit final schedule after samples, product data, coordination

with shop drawings of other work, delivery schedules, and similar information has been completed and accepted.

- C. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of work of other appropriate Sections to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

#### 1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor for consultation.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.
- C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.
- D. Deliver individually packaged door hardware items promptly to place of installation.
- E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.
- F. Keys shall be delivered directly to City of Madison Project Manager in packaging separate from other hardware. Obtain receipt and confirmation of delivery in writing with copies to be delivered to Architect and Owner's Construction Representative.

#### 1.6 WARRANTY

- A. Manufacturer's written guarantee for periods of time as follows beginning from date of substantial completion.
  - 1. Closers: Ten years.
  - 2. Lacquer finishes: Two years.
  - 3. Polyurethane finishes: Five years.

4. All other hardware: One year.

## 1.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:
  1. Manufacturer's Product Designations: The product designation and name of the manufacturer are listed for each hardware type required for the purpose of establishing Owner's requirements. Provide the product designated or, where specific product is not designated, the product of the manufacturer(s) that complies with requirements.
- B. Manufacturers: Subject to compliance with Owner's requirements, provide products by the following:
  1. Hinges-Hager or Approved Equal
  2. Cylinders and keys.-Schlage or Approved Equal
  3. Locksets.- Schlage, Best, or Approved Equal
  4. Lever Handles- Schlage, Best, or Approved Equal
  5. Closers- Schlage, Best, or Approved Equal
  6. Door Stops- Hager, HB Ives, or Approved Equal
  7. Thresholds and Door Weather Strips- Reese, or Approved Equal
  8. Deadbolts: Schlage, or Approved Equal
  9. Floor Stops: Ives, or Approved Equal

### 2.2 MATERIALS AND FABRICATION

- A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.
  1. Manufacturer's identification will be permitted on rim of lock cylinders only.
- B. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
- C. Furnish screws for installation with each hardware item. Provide slotted-head screws sized as appropriate for each item or to match sizes on existing hardware. Finish exposed (exposed under

any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of other work as closely as possible.

- D. Provide concealed fasteners for hardware units that are exposed when door is closed unless units of type specified are not available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use hex screw fasteners.

## 2.3 KEYING

- A. Key Material: Provide keys of nickel silver only.
- B. Key Quantity: Furnish 3 change keys for each lock.
  - 1. Furnish one extra blank for each lock.
  - 2. Deliver keys to Owner.

## 2.4 FINISHES

- A. Finishes as indicated above for specified hardware are to be from manufacturers range of standard finishes. Sample to be approved by Architect.
- B. All Hardware shall be factory finished in color to match samples.
- C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- D. Provide protective transparent, dull finish polyester or other approved coating on all exposed hardware surfaces to protect hardware for minimum of two years.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated otherwise or as otherwise directed by Architect.
  - 1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.



- C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

### 3.2 FINAL ADJUSTING AND CHECKING

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
  - 1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- B. Any hardware item or unit proving to be defective as to material, construction or finish during final inspection by Architect or during warranty period shall be replaced in its entirety by the Contractor at own expense.
- C. Clean adjacent surfaces soiled by hardware installation.
- D. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

### 3.3 HARDWARE SCHEDULE

- A. The hardware groups for each door are listed in the Hardware Schedule on Sheet A6.1 of the Drawing Set.

END OF SECTION



## SECTION 09 22 16

### NON-STRUCTURAL METAL FRAMING

#### 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. Non-load-bearing steel framing systems for partitions.

- B. Related Requirements:

- 1. Section 05 40 00 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs.

##### 1.3 SUBMITTALS

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

- B. Product Certificates: For each type of code-compliance certification for studs and tracks.

##### 1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft. (239 Pa).

## 2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  - 2. Protective Coating: ASTM A 653/A 653M, G40 (Z120) hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C 645.
- C. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  - 1. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm).
  - 2. Depth: 7/8 inch (22.2 mm).
- D. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

## 2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
  - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.3 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum **1/2-inch (13-mm)** clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- E. Direct Furring:
  - 1. Screw to wood framing.

2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION

## SECTION 09 29 01

### WALL BOARD

#### 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. Backing panels for finishing with plastic paneling.

##### 1.3 SUBMITTALS

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

##### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

##### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 BACKING PANELS

- A. Cementitious Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
  - 1. Acceptable Manufacturers:
    - (a) James Hardie
    - (b) Johns Manville
    - (c) US Gypsum
  - 2. Core: 1/2 inch (12.7 mm), regular type.
  - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

### 2.2 TRIM ACCESSORIES

- A. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
  - 1. Aluminum: Alloy and temper with not less than the strength and durability properties of **ASTM B 221 (ASTM B 221M)**, Alloy 6063-T5.

### 2.3 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  - 1. Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Backing Panels:
  - 1. Cementitious Backer Units: As recommended by backer unit manufacturer.

### 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from **0.033 to 0.112 inch (0.84 to 2.84 mm)** thick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."
- D. Vapor Retarder: 3mil poly.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch (1.5 mm)** of open space between panels. Do not force into place.
- C. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- D. Form control and expansion joints with space between edges of adjoining gypsum panels.
- E. Isolate perimeter of board applied to non-load-bearing partitions at structural abutments. Provide **1/4- to 1/2-inch- (6.4- to 12.7-mm-)** wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- F. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

### 3.3 APPLYING BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at where wall board is indicated.
- B. Where backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

### 3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

### 3.5 FINISHING GYPSUM BOARD

- A. General: Treat wall board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare wall board surfaces for plastic paneling lamination. Promptly remove residual joint compound from adjacent surfaces.
- B. Cementitious Backer Units: Finish according to manufacturer's written instructions.

### 3.6 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 67 23  
RESINOUS FLOORING

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 resinous flooring systems.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 SUBMITTALS

- A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Initial Selection: For each type of exposed finish required.
- C. Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.
- D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- E. Material Certificates: For each resinous flooring component, from manufacturer.
- F. Material Test Reports: For each resinous flooring system, by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

- B. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Apply full-thickness mockups on 96-inch- (2400-mm-) square floor area selected by Architect.
  - 2. Simulate finished lighting conditions for Architect's review of mockups.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

#### 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Flammability: Self-extinguishing according to ASTM D 635.

#### 2.2 MANUFACTURERS

- A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

## 2.3 RESINOUS FLOORING

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.
  - 1. Acceptable manufacturers:
    - a. Applied Flooring Technologies
    - b. Laticrete
    - c. Dur-A-Flex
    - d. J Wesselman
- B. System Characteristics:
  - 1. Color and Pattern: As selected by Architect from manufacturer's full range.
  - 2. Wearing Surface: Textured for slip resistance.
  - 3. Overall System Thickness: 20 mils (0.5 mm).
  - 4. Federal Agency Approvals: USDA approved for food-processing environments.
- C. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.
  - 1. Formulation Description: 100 percent solids.
- D. Waterproofing Membrane: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.
  - 1. Formulation Description: High solids.
- E. Reinforcing Membrane: Flexible resin formulation that is recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated and that inhibits substrate cracks from reflecting through resinous flooring.
  - 1. Formulation Description: High solids.
    - a. Provide fiberglass scrim embedded in reinforcing membrane.
- F. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- G. Body Coats:  
Resin: Epoxy.
  - 1. Formulation Description: 100 percent solids.
  - 2. Type: Pigmented.
  - 3. Application Method: Self-leveling slurry with broadcast aggregates.
  - 4. Number of Coats: Two.
  - 5. Thickness of Coats: 8 mils.
  - 6. Aggregates: Manufacturer's standard.
- H. Grout Coat:
  - 1. Resin: Epoxy.
  - 2. Formulation Description: 100 percent solids.
  - 3. Type: Pigmented.
  - 4. Thickness of Coat: 8 mils (0.2 mm).

- I. Topcoats: Sealing or finish coats.
  - 1. Resin: Epoxy.
  - 2. Formulation Description: High solids.
  - 3. Type: Clear.
  - 4. Number of Coats: Two.
  - 5. Thickness of Coats: 8 mils (0.2 mm).
  - 6. Finish: Gloss.
  
- J. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
  - 1. Compressive Strength: minimum according to ASTM C 579.
  - 2. Tensile Strength: minimum according to ASTM C 307.
  - 3. Flexural Modulus of Elasticity: minimum according to ASTM C 580.
  - 4. Water Absorption: percent maximum according to ASTM C 413.
  - 5. Shrinkage: percent maximum according to ASTM C 531.
  - 6. Indentation: percent maximum according to MIL-D-3134J.
  - 7. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch (1.6-mm) permanent indentation according to MIL-D-3134J.
  - 8. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch (1.6 mm) according to MIL-D-3134J.
  - 9. Abrasion Resistance: maximum weight loss according to ASTM D 4060.
  - 10. Hardness: Shore D according to ASTM D 2240.
  - 11. Critical Radiant Flux: 0.45 W/sq. cm or greater according to NFPA 253.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
  
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
  - 1. Roughen concrete substrates as follows:
    - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    - b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
  
  - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
  
  - 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

- a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 4 lb of water/1000 sq. ft. (2.04 kg of water/92.9 sq. m) of slab area in 24 hours.
  - b. Plastic Sheet Test: ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
  - c. Relative Humidity Test: Use in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- 1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.
- D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

### 3.2 APPLICATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
- 1. Apply resinous flooring system at exposed and semi-exposed floor area within concession addition portion of project.
  - 2. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  - 3. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
  - 4. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Waterproofing Membrane: Apply waterproofing membrane in manufacturer's recommended thickness.
- 1. Apply waterproofing membrane to integral cove base substrates.
- D. Reinforcing Membrane: Apply reinforcing membrane to entire substrate surface.
- E. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
- 1. Integral Cove Base: 4 inches (100 mm) high.

- F. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness indicated for flooring system.
  - 1. Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
- G. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.
- H. Grout Coat: Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat.
- I. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

### 3.3 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may, at any time and any number of times during resinous flooring application, require material samples for testing for compliance with requirements.
  - 1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
  - 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
  - 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.
- B. Core Sampling: At the direction of Owner and at locations designated by Owner, take one core sample per 1000 sq. ft. (92.9 sq. m) of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring. Correct deficiencies in installed flooring as indicated by testing.

### 3.4 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION



## SECTION 09 90 00

### PAINTING AND COATINGS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 govern work of the Section.

##### 1.2 SUMMARY

- A. Work of this Section includes surface preparation, painting, and finishing of exposed items and surfaces including the following:
  - 1. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.
- B. Related Work.
  - 1. Division 08 Section "Hollow Steel Doors and Frames".
  - 2. Division 08 Section "Metal Windows".
  - 3. Division 03 Section "Concrete"
  - 4. Division 04 Section "Unit Masonry".
- C. Painting is not required on pre-finished items, finished metal surfaces, concealed surfaces and operating parts.

##### 1.3 DEFINITIONS

- A. "Paint" includes opaque coating materials, primers, emulsions, enamels, stains, fillers, and other applied materials whether used as prime, intermediate, or finish coats.

##### 1.4 SUBMITTALS

- A. Samples for color selection in the form of manufacturer's color charts.
- B. Before the start of work in any area, provide the Owner with one full, sealed, unused and properly labeled quart of paint of each color used. Include the mix formula for each color and a 5" x 10" masonite board painted with the color and properly labeled with location, room number and paint color and name.

##### 1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

- B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates.
- C. Material Quality: Provide the named manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
  1. Product name or title of material.
  2. Product description (generic classification or binder type).
  3. Federal Specification number, if applicable.
  4. Manufacturer's stock number and date of manufacture.
  5. Contents by volume, for pigment and vehicle constituents.
  6. Thinning instructions.
  7. Application instructions.
  8. Color name and number.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45°F (7°C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
- C. Protect materials from freezing. Keep storage area neat and orderly. Remove oily rags and waste from site daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

## 1.7 JOB CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50°F and 90°F.
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45°F and 95°F.
- C. Do not apply paint when the relative humidity exceeds 85 percent, at temperatures less than 5°F above the dew point, or to damp or wet surfaces.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Unless noted otherwise, products named conform to Federal Specification FS TT-P-29.

## 2.2 MASONRY BLOCK FILLER

- A. High-Performance Latex Block Filler: Heavy-duty latex block fillers used for filling open textured interior and exterior concrete masonry block before application of top coats:

1. P & L: Pro-Hide Plus Block Filler.

## 2.3 PRIMERS

- B. Interior Alkyd Primer: FS TT-S-179B, Type 1; To be used as a primer on plaster, masonry, concrete.

2. P & L: Supreme "12" Interior Alkyd Primer.

- C. Interior wood primer: FS TT-P-659C, For priming wood trim.

1. P & L: Supreme "11" Interior Alkyd Primer.

- D. Exterior Primer Coating: FS TT-P-620C; Exterior alkyd wood primer for priming wood under alkyd gloss enamels, flat lusterless finish.

1. P & L: Suprime "8" Exterior Alkyd Primer.

- E. Exterior Primer Coating: Exterior alkyd primer for ferrous metals.

1. P & L Effecto Rust Inhibiting Primer.

## 2.4 EXTERIOR FINISH PAINT MATERIAL

- A. Alkyd Semi-Gloss Enamel: FS TT-P-102D; Weather-resistant, air-drying, high gloss enamel for use on the exterior over prime-coated wood siding, trim, windows and galvanized, prime coated ferrous metals:

1. P & L: Permalize House and Trim Finish.  
2. Approved Equal

## 2.5 INTERIOR FINISH PAINT MATERIAL

- A. F. Interior Gloss Paint: FS TT-P-002119; Latex (Acrylic) enamel for use over primed concrete and masonry.

1. P & L: Accolade High Gloss.

## 2.6 PAINT STRIPPER

- A. Strippers: Nonvolatile, nonsolvent, low odor type product using products such as organic esters.  
B. Solvent-based; methylene chloride type strippers are not allowed.  
C. Product as approved by Architect.

- D. Rinse shall be mineral spirits or other materials as recommended by the stripper manufacturer.
- E. See Division 04 Section "Unit Masonry Restoration" for paint removal on masonry.

## 2.7 CONCRETE SEALER

- A. Clear Sealer: Brock-White concrete sealer.
- B. Approved equal.

## 2.8 ACCESSORY MATERIALS

- A. Concrete Floors:
  - 1. P & L Non-Slip Additive.
  - 2. P & L Commercial solution of muriatic acid.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.
- B. Start of painting will be construed as the contractor's acceptance of and responsibility for surfaces and conditions within a particular area to produce acceptable painted surfaces.

### 3.2 PREPARATION

- A. General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.
  - 1. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning.
  - 2. Coordinate with other trades when scheduling cleaning and painting so that dust and other contaminants from work of other trades and the cleaning process will not fall on wet, newly painted surfaces.
- B. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.
  - 1. Painter shall be responsible for minor repairs to fine cracks and hole fills required to achieve an acceptable painting surface. Start of painting in each room implies acceptance of surface. Notify Architect prior to start of work of conditions requiring greater effort than minor repair.

2. All surfaces to be painted shall be primed. Notify Architect in writing of problems anticipated with using the specified finish-coat material with substrates primed by others.
  3. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze.
    - a. Allow concrete floors to dry for a minimum of 90 days prior to painting.
    - b. Determine alkalinity and moisture content of cementitious surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, notify Architect and correct this condition per paint manufacturer's requirements. Provide test results in writing to Architect.
    - c. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
    - d. Clean concrete floors to be painted with a solution of one part muriatic acid or other etching cleaner and eight parts water. Flush the floor with ammonia water followed by clean water to remove acid, neutralize with ammonia, and rinse; allow to dry and vacuum before painting.
  4. Ferrous Metals: Clean nongalvanized 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 recommendations of the Steel Structures Painting Council.
- C. Paint Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.
1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
  2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
  3. Use only thinners approved by the paint manufacturer, and only within recommended limits.

### 3.3 APPLICATION

- A. General.
1. Apply paint in accordance with manufacturer's directions. Use brush and roller applicators and techniques best suited for substrate and type of material being applied. Technique shall be defined as the method in which the applicator is used. No pads are allowed.
  2. For roller use, use 3/8 inch knap cover for all paints. A longer knap cover is acceptable for block fill products.
  3. Final colors shall be as selected and approved by Architect.
  4. The number of coats and film thickness required is the same regardless of the application method.
  5. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer.
  6. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions and project requirements.
  7. Apply additional coats of final paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.

8. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.
  9. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
  10. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.
  11. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
  12. Omit primer on metal surfaces that have been shop-primed and touch-up painted.
  13. Labels: Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- B. Scheduling Painting: 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.
1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- C. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer or noted herein.
- D. Mechanical and Electrical Work: Painting mechanical and electrical work is limited to items exposed in mechanical equipment rooms and in occupied spaces.
- E. Mechanical items to be painted include but are not limited to:
1. Piping, pipe hangers, and supports in Rooms 107, 109 and exterior surface mounted locations. See paint schedule.
  2. Inside faces of supply and return diffusers and visible ductwork in Rooms 108, 113, 114 and 116. See paint schedule.
- F. Electrical items to be painted include but are not limited to:
1. Conduit and fittings. See paint schedule.
  2. Switchgear. See paint schedule.
  3. Panel covers. See paint schedule.
- G. Prime Coats: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted or finished and 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 assure a finish coat with no burn through or other defects due to insufficient sealing. Tinting of primers is not acceptable.
- H. Paint Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, burn through, inconsistent sheen, flashing or other surface imperfections will not be acceptable.

1. Paint colors, surface treatments, and finishes are to match original existing work.
  2. Apply paint evenly with brush or roller as appropriate. Brush out corners and crevices to avoid build-up. Drips, streaks, runs, brush or roller marks and visible lines of stops and starts are not acceptable.
  3. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
- I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

#### 3.4 FIELD QUALITY CONTROL

- A. The Architect will conduct inspection of primer applications on floor by floor basis prior to application of final finish coats.

#### 3.5 CLEANING

- A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
- B. Upon completion of painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

#### 3.6 PROTECTION

- A. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.
- B. Provide "wet paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.
- C. Touch up and restore damaged or defaced painted surfaces at completion of other trades' activities and in compliance with final punch list by Architect.

#### 3.7 SCHEDULE

- A. Concrete: 3 coats (primer, two topcoats); total dry film thickness not less than 3.5 mils.
- B. Ferrous Metal: 3 coats (primer, two topcoats); total dry film thickness not less than 2.5 mils.

END OF SECTION





## SECTION 10 14 00

### SIGNAGE

#### 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. Plastic ADA compliant exterior and interior signs.

##### 1.3 SUBMITTALS

- A. Submit shop drawings: Indicate sign styles, lettering font, foreground and background colors, locations, overall dimensions of each sign.
- B. Submit material and color samples.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Plastic ADA signs
  - 1. Quartet- ADA signs
  - 2. Approved Equal

##### 2.2 SIGN SCHEDULE

- A. Provide the following plastic ADAAG signs:
  - 1. Model #QRTO1416, ADA Sign: Men's Restroom, qty. 1
  - 2. Model #QRTO1415, ADA Sign: Women's Restroom, qty. 1
  - 3. Accessible ADA Entrance Sign, qty. 2

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work. Mounting locations should be smooth and free of all dirt, dust, grease, etc.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and all ADAAG and ANSI standards for persons with disabilities.
- B. Mount signs level and plumb using manufacturer's standard mounting hardware of vinyl foam tape or holes and screws. No screws or bolts are to be applied through face of sign.
- C. Remove excess adhesives, etc. from exposed sign surfaces as recommended by adhesive manufacturer. Clean sign surfaces as needed.

END OF SECTION

## SECTION 10 21 13

### PLASTIC TOILET COMPARTMENTS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:

- 1. Solid-plastic toilet compartments configured as toilet enclosures and urinal screens.

- B. Related Requirements:

- 1. Section 10 28 00 "Toilet Accessories" for toilet tissue dispensers, grab bars, and similar accessories mounted on toilet compartments.

##### 1.3 SUBMITTALS

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

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

- B. Shop Drawings: For toilet compartments.

- 1. Include plans, elevations, sections, details, and attachment details.
  - 2. Show locations of cutouts for compartment-mounted toilet accessories.
  - 3. Show locations of centerlines of toilet fixtures.
  - 4. Show locations of floor drains.

- C. Samples: For each type of toilet compartment material indicated.

- 1. Include Samples of hardware and accessories involving material and color selection.
  - 2. Each type of material, color, and finish required for toilet compartments, prepared on **6-inch- (152-mm-)** square Samples of same thickness and material indicated for Work.
  - 3. Each type of hardware and accessory.

- D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and source.
  - 1. Door Hinges: One hinge with associated fasteners.
  - 2. Latch and Keeper: One latch and keeper with associated fasteners.
  - 3. Door Bumper: One bumper with associated fasteners.
  - 4. Door Pull: One door pull with associated fasteners.
  - 5. Fasteners: Ten fasteners of each size and type.

#### 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

#### 2.2 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Manufacturers:
  - 1. ASI Global Partitions
  - 2. Bradley, Inc.
  - 3. Hadrian, Inc.
  - 4. Scranton Products

- B. Toilet-Enclosure Style: Floor anchored.
- C. Entrance-Screen Style: Floor anchored.
- D. Urinal-Screen Style: Wall hung.
- E. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than **1 inch (25 mm)** thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
  - 1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
  - 2. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
  - 3. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range.
- F. Pilaster Shoes and Sleeves Caps: Manufacturer's standard design; stainless steel.
  - 1. Polymer Color and Pattern: As selected by Architect from manufacturer's full range.
- G. Brackets (Fittings):
  - 1. Stirrup Type: Ear or U-brackets, stainless steel.
  - 2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
    - a. Polymer Color and Pattern: As selected by Architect from manufacturer's full range.

## 2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.
  - 1. Hinges: Manufacturer's minimum **0.062-inch- (1.59-mm-)** thick stainless-steel paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees allowing emergency access by lifting door. Mount with through-bolts.
  - 2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
  - 3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
  - 4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors. Mount with through-bolts.
  - 5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

## 2.4 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).
- B. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- C. Stainless-Steel Castings: ASTM A 743/A 743M.

## 2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Door Size and Swings: Unless otherwise indicated, provide ~~24-inch-~~ (610-mm-) wide, in-swinging doors for standard toilet compartments and ~~36-inch-~~ (914-mm-) wide, out-swinging doors with a minimum ~~32-inch-~~ (813-mm-) wide, clear opening for compartments designated as accessible.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
  - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels: **1/2 inch (13 mm)**.
    - b. Panels and Walls: **1 inch (25 mm)**.
  - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
    - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than **1-3/4 inches (44 mm)** into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than **2 inches (51 mm)** into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

### 3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION





## SECTION 10 28 00

### TOILET ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Accessories for toilet rooms
  - 2. Grab bars.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Accessories: Products listed are made by American Specialties, Inc; or an approved equal
- B. Hand Dryer: World Dryer Corporation; [www.worlddryer.com](http://www.worlddryer.com); Telephone: 1-800-323-0701, or an approved equal
- C. All items of each type to be made by the same manufacturer.

##### 2.2 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Keys: Provide 4 keys for each accessory to Owner; master key all lockable accessories.

##### 2.3 TOILET ROOM ACCESSORIES

- A. Toilet Paper Dispenser: Model # 0030, surface mounted dual roll, type 304 stainless steel. Qty: 2
- B. Electrically operated- Air Powered Hand Dryer: Model A. Qty: 2
- C. Mirror: Model # 0620, 18"W x 36"H, channel frame, stainless steel. Qty: 4

- D. Grab Bars: 1-1/2 inches outside diameter, minimum 0.05 inch wall thickness, non-slip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
  - 1. 3200 Series
  - 2. Type - 56 configuration and Type - 01 configuration
  - 3. Stainless steel with satin finish
  - 4. Qty: Refer to Drawings.
  
- E. Baby Changing Station: Vertical unit that opens by folding down from stored position and with child protective strap. Engineered to support a minimum of 250-lb. (113-kg) static load when opened. Polystyrene tray liner and rounded plastic corners.
  - 1. Bobrick Koala Kare Products, Model KB 101-00; or approved equal.
  - 2. Qty: two (2).
  
- F. Soap Dispenser: Vertical stainless steel, surface mounted
  - 1. 0347 Series
  - 2. Type - 56 configuration and Type - 01 configuration
  - 3. Stainless steel with satin finish
  - 4. Qty: four (4).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on drawings.

### 3.2 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights and Locations: As required by accessibility regulations and as indicated on drawings

END OF SECTION

## SECTION 10 44 00

### FIRE PROTECTION SPECIALTIES

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. Fire Extinguishers.
- B. Fire Extinguisher Cabinets.
- C. Accessories

##### 1.03 REFERENCES

- A. NFPA 10 - Standard for Portable Fire Extinguishers; 1998

##### 1.04 PERFORMANCE REQUIREMENTS

- A. Conform to NFPA 10.
- B. Provide extinguishers classified and labeled Underwriters Laboratories Inc. for the purpose specified and indicated.

##### 1.05 SUBMITALS

- A. Shop Drawings: Indicate cabinet physical dimensions.
- B. Product Data: Provide extinguisher operational features.
- C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- D. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

##### 1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Fire Extinguishers, Cabinets and Accessories
  - 1. Potter Roemer; 769 Edgewood Avenue, Wood Dale, IL 60191; Tel: (630) 766-4545.
  - 2. Substitutions: See AIA Document A201 - 1997 Edition.

##### 2.02 FIRE EXTINGUISHERS

- A. Model No.: 3005.
- B. Quantity: 4

##### 2.03 FIRE EXTINGUISHER CABINET

- A. Model No. 7072-B
- B. Quantity: 2

## 2.04 ACCESSORIES

- A. Wall Mounting Bracket Model No.: 3902
- B. Quantity: 2

END OF SECTION

## SECTION 10 73 13

### AWNINGS

#### 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. Fixed awnings.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include styles, material descriptions, construction details, fabrication details, dimensions of individual components and profiles, hardware, fittings, mounting accessories, features, and finishes for awnings.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, mounting heights, and attachment details.
  - 2. Detail fabrication and assembly of awnings.
  - 3. Include diagrams for power, signal, and control wiring.
  - 4. Show locations for blocking, reinforcement, and supplementary structural support.
  - 5. Graphics: Show text message, font, character sizes, and other graphic forms; character, word, and line spacing; margin widths; position of copy; and other information related to graphic design.
- C. Samples: For each exposed product and for each color and texture specified.
  - 1. Seam, Edge, and Corner Condition: Not less than **12-inch- (300-mm-)** long section showing seam, edge, and corner treatment.
  - 2. Frame Finish: Not less than **6-inch (150-mm)** lengths.

##### 1.4 SUBMITTALS

- A. Operation and Maintenance Data: For awnings to include in operation and maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of products.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer and fabricator agree to repair or replace components of awnings that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including framework.
    - b. Deterioration of fabric including seam failure.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - d. Faulty operation of operator.
  - 2. Awning Warranty Period: **Five** years from date of Substantial Completion.
  - 3. Fabric Warranty Period: **Five** years from date of Substantial Completion.
  - 4. Thread Warranty Period: **Five** years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Fire-Test-Response Characteristics: Provide awning fabrics with the fire-test-response characteristics indicated, as determined by testing identical products according to test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

Flame-Resistance Ratings: Passes NFPA 701.

- 1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency for Flame-Spread Index of 25 or less.

## 2.2 FABRIC

- A. Manufacturers:
  - 1. Sunbrella
  - 2. Softek
  - 3. US Canvas
  
- B. Fabric:
  - 1. Fiber Content: Vinyl-laminated or -coated polyester mesh.
  - 2. Mildew Resistance: Showing no growth when tested according to ASTM G 21.
  - 3. Shrinkage: Not greater than 0.1 percent according to ASTM D 1204.
  - 4. Stretch Factor: Not less than 0.4 percent according to ASTM D 4851.
  - 5. Applied Treatment: Stain resistant, Mildew resistant.
  - 6. Pattern and Color: One solid color as selected by Architect from manufacturer's full range.
  
- C. Seam Thread: 100 percent expanded PTFE, UV-light, mildew, and rot resistant.

## 2.3 AWNING FRAME AND ACCESSORY MATERIALS

- A. Aluminum: Alloy and temper recommended by awning manufacturer for type of use and finish indicated and with not less than the strength and durability properties of alloy and temper required by structural loads.
  - 1. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M).
  - 2. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).
  - 3. Extruded Structural Pipe Tubing: ASTM B 429/B 429M, standard weight (Schedule 40).
  - 4. Drawn Seamless Tubing: ASTM B 210 (ASTM B 210M).
  
- B. Anchors, Fasteners, Fittings, Hardware, and Installation Accessories: Complying with performance requirements indicated and suitable for exposure conditions, supporting structure, anchoring substrates, and installation methods indicated. Corrosion-resistant or noncorrodible units; weather-resistant, compatible, non-staining materials. Provide as required for awning assembly, mounting, and secure attachment. Number as needed to comply with performance requirements and to maintain uniform appearance; evenly spaced. Where exposed to view, provide finish and color as selected by Architect from manufacturer's full range.
  - 1. Wood Screws: ASME B18.6.1.
  - 2. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
  - 3. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.
  - 4. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing according to ASTM E 488 conducted by a qualified independent testing and inspecting agency.

- a. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).
5. Adhesive-Bonded Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing according to ASTM E 1512 conducted by a qualified independent testing and inspecting agency.
- a. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

## 2.4 AWNING FABRIC FABRICATION

- A. Fabrication: Reinforce wear points and hardware attachment points with webbing. Seam fabrics as follows:
  - 1. Fabric Edges and Seams: Fold and stitch selvedge and cut fabric edges.

## 2.5 FIXED AWNING FABRICATION

- A. Manufacturers:
  - 1. Baraboo Tent and Awning
  - 2. Gallagher Tent and Awning
  - 3. Naegele Awning Company
- B. Frame
  - 1. Frame Fabrication: Fabricate awning frames from aluminum. Preassemble in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
  - 2. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
  - 3. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Fabricate slip-fit connections exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
  - 4. Weld corners and connections continuously. Obtain fusion without undercut or overlap. Remove welding flux immediately. At exposed corners and connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
  - 5. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure awnings in place and to properly transfer loads.
- C. Aluminum Finish: Mill finish complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- A. General: Install awnings at locations and in position indicated, securely connected to supports, free of rack, and in proper relation to adjacent construction. Use mounting methods of types described and in compliance with Shop Drawings and fabricator's written instructions.
- B. Install awnings after other finishing operations, including joint sealing and painting, have been completed.
- C. Slip fit frame connections accurately together to form hairline joints, and tighten to secure.
- D. Weld frame connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
  - 1. Field Welding: Comply with the following requirements:
    - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
    - b. Obtain fusion without undercut or overlap.
    - c. Remove welding flux immediately.
    - d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- E. Anchoring to In-Place Construction: Use anchors, fasteners, fittings, hardware, and installation accessories where necessary for securing awnings to structural support and for properly transferring load to in-place construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come in contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.
- G. Coordinate awning installation with flashing and joint-sealant installation so these materials are installed in sequence and in a manner that prevents exterior moisture from passing through completed exterior wall and roof assemblies.

3.3 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly, and lubricate as recommended by retractable-awning manufacturer.

3.4 CLEANING AND PROTECTION

- A. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION

**SECTION 11 40 00  
FOODSERVICE EQUIPMENT**

**PART 1 – GENERAL**

**SCOPE**

This section includes specifications for foodservice equipment. Included are the following topics:

**PART 1 – GENERAL**

- Scope
- Definitions and Abbreviations
- Codes and Standards
- Description of Work
- Related Work by Other Contractors
- Equipment Warranty
- Submittals
- Project Conditions and Verification

**PART 2 – PRODUCTS**

- General
- Custom Fabrication and Materials
- Exhaust Hoods
- Cold Storage Rooms
- Refrigeration Systems
- Electrical Requirements
- Plumbing Requirements

**PART 3 – EXECUTION**

- Delivery Storage and Handling
- FEC Installation
- Start-up and Testing
- Cleaning
- Protection of Completed Work
- Maintenance

**PART 4 – ITEM SPECIFICATIONS**

- Rough-in Drawings
- Approved Fabricators
- Alternates and Substitutions
- Equipment Specifications

## **PART 1 – GENERAL**

### **1.01 SCOPE:**

Provide labor, equipment, and material, and perform all necessary procedures for installation of foodservice equipment. Work shall be in accordance with the Contract Documents and shall include all miscellaneous labor and materials which is reasonably inferred for installation of foodservice equipment.

### **1.02 DEFINITIONS AND ABBREVIATIONS**

- A. PROVIDE – Supply all materials, labor and equipment necessary for final connection.
- B. FURNISH – Supply and deliver equipment ready for installation.
- C. INSTALL – Set in place, level, secure and connect.
- D. Abbreviations

ADA	Americans Disabilities Act
AFF	Above Finished Floor
AGA	American Gas Association
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society for Mechanical Engineers
EC	Electrical Contractor
FEC	Foodservice Equipment Contractor
GC	General Contractor
HVAC	Heating, Ventilation and Air Conditioning Contractor
MC	Mechanical Contractor
NEC	National Electric Code
NEMA	National Electric Manufacturer's Association
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Agency
PC	Plumbing Contractor
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
UL	Underwriters Laboratory

### **1.03 CODES AND STANDARDS**

- A. Ordinances and Laws: All work to comply with all prevailing ordinances, laws, codes and regulations related to construction and installation.
- B. Standards: All equipment must comply with ADA, AGA, ASHRAE, ASME, NEC, NEMA, NFPA 17A, 54, 70 and 96, NSF, OSHA and UL.
- C. Extra charges for the providing of items or furnishing work which is required by the regulations even though items required may not be specifically called for on the drawings or in the specifications will not be paid. Should a conflict occur between these codes and the equipment specified, the code will take precedence. Notification of the code variance shall be made to the Architect.

#### 1.04 DESCRIPTION OF WORK

- A. Equipment: Fabricate, deliver, unload, uncrate, assemble, set in place and level equipment for final connection by appropriate trades.
- B. Coordination:
  - 1. Coordinate all mechanical, plumbing and electrical rough-in services including field verification of all stub-up and rough-in locations before flooring is poured and before walls and ceilings are finished. FEC to notify Architect and Consultant of any discrepancies.
  - 2. Coordinate existing building conditions and all other building conditions related to the installation of Section 11 40 00 equipment with GC.
  - 3. Coordinate requirements for all existing equipment, owner furnished equipment, future equipment and purveyor supplied equipment with appropriate trades.
  - 4. Verify all delivery access, wall openings and overhead obstructions for delivery and installation of large equipment.
  - 5. Supervise and inspect final connections of utilities to foodservice equipment.
- C. Schedule: Perform work in a timely manner in accordance with the construction schedule. Submit written notice to Foodservice Consultant, Architect and General Contractor of any construction or manufacturer related problems that may cause delay in the delivery or installation of equipment. Substitutions for failing to order equipment in a timely manner are not acceptable.
- D. Contract Documents: Drawings and Specifications are intended to be advisory and for informational purposes only. Contract Documents are not intended to be and shall not be used for construction purposes.
- E. Document discrepancy: If drawings and specifications contain conflicting information, FEC to request clarification in writing or provide equipment and work of better quality and quantity. FEC is responsible for all costs incurred from the failure to request resolution of conflicting requirements.
- F. Model Number Changes: When specified equipment is no longer available, the Owner reserves the right to accept the manufacturer's replacement Model number or equipment specified as equal.
- G. Equipment verification: Verify sizes of trays, racks, dinnerware and pans prior to fabrication or ordering of equipment.
- H. Qualifications: FEC to provide a jobsite supervisor with experience successfully completing two projects of similar size. Supervisor must be able to coordinate with all trades for electrical, plumbing and HVAC requirements.
- I. Permits, Licenses and Inspections: Schedule and pay for all permits, inspections and testing required by prevailing agencies and codes related to the installation of Section 11 40 00 equipment. Supply owner and GC with copies of all certificates of compliance from inspections and testing.

J.  
1.05 RELATED WORK BY OTHER CONTRACTORS

A. General Contractor (GC)

1. Provide flooring material and base inside and outside of walk-in coolers and freezers manufactured and installed to withstand temperatures below -20° Fahrenheit. Provide base, slab insulation, concrete setting bed and vapor barrier as shown on Section 11 40 00 drawings.
2. Provide concealed wall backing to support all wall mounted equipment as shown on Section 11 40 00 drawings.
3. Install floor troughs and floor pans provided by FEC.
4. Provide all required floor penetrations, wall sleeves, equipment pads and roof curbs for refrigeration systems.
5. Provide all flooring, ceiling finishes and wall finish materials unless indicated on Section 11 40 00 drawings and specifications.

B. Plumbing Contractor (PC)

1. Provide rough-in and final connections to all equipment requiring plumbing services. Flush all lines of contamination prior to connecting all fixtures.
2. Provide all water supply piping, drain lines, drain assemblies, floor drains, valves, traps, tailpieces, pressure reducing valves, shut-off valves, flow control valves, check valves, backflow prevention, etc. that are necessary for the complete installation of Section 11 40 00 equipment unless indicated in Plumbing Schedule as furnished by the FEC.
3. Provide eye wash stations, mop sinks and hose bibbs unless indicated in Plumbing Schedule as furnished by the FEC.
4. Provide gas pressure reducing and regulation valves for pressures above 14" W.C.
5. Provide PVC conduit with wide radius elbows for passage of beverage and refrigeration lines.
6. Provide copper condensate lines for walk-in cooler/freezer. Attach condensate lines securely to the walls of the walk-in cooler/freezer. Trap drain lines on the exterior of walk-in cooler/freezer. Coordinate installation of heat tape for walk-in freezers with electrical contractor.
7. Install all faucets, drains, vacuum breakers, valves, water inlets, traps, filters, PRV's, gauges, gas valves, gas hoses, flexible water hoses, pressure regulators, etc. furnished by the FEC.
8. Interconnect and assemble all plumbing components, piping and systems of Section 11 40 00 equipment which requires field assembly.

#### C. Electrical Contractor (EC)

1. Provide all systems and services including wiring to and final connections of all foodservice equipment and components.
2. Provide all receptacles, conduit, controls, starters, disconnects, switches, etc. that are necessary for the complete and proper installation of section 11 40 00 equipment.
3. Provide water proof conduit, electrical boxes and Ground Fault Interrupter receptacles in wet areas.
4. Provide shunt trip breakers and contactors as indicated on Section 11 40 00 drawings. Wire from fire suppression system controls to shunt trip breakers.
5. Install all control circuits for fire suppression systems, exhaust hoods, condensate hoods, refrigeration systems, electrical load systems and waste systems.
6. Install all electrical mechanisms provided by FEC.
7. Whenever possible shall stub-out of walls rather than stub up through floor. Conceal all electrical conduit when possible. No unnecessary exposed wiring permitted. Use polished chrome conduit where exposed.
8. Mount all receptacles above work surfaces horizontally. Provide stainless steel cover plates.
9. Interconnect and assemble all electrical components, exhaust hoods, refrigeration systems and all walk-in cooler/freezer components.
10. All materials and components shall be UL approved and labeled and installed in accordance with NEMA standards.
11. EC and FEC shall verify that the voltage on the job corresponds with the equipment drawings and specifications before ordering any electrical equipment. All equipment shall be grounded.

#### D. Mechanical Contractor (MC)

1. Provide all systems and services including exhaust ducts, fans, dampers, starters, etc. necessary for the operation of Type I and type II exhaust hoods.
2. Provide rough-in and final connections required for Section 11 40 00 equipment requiring HVAC services.
3. All installation must conform to NFPA 96 and prevailing codes.

#### 1.06 EQUIPMENT WARRANTY

- A. General: All equipment to carry one year parts and labor warranty from date of demonstration or owner acceptance by owner or architect. Parts or equipment failure due to material defect or improper installation shall be repaired or replaced at no cost to the owner during this time.

- B. Refrigeration Systems: One year refrigeration system parts and labor with an additional four years compressor, condenser and evaporator coil warranty. Refrigerant lost due to a leak in the system or faulty equipment shall be included in warranty.
- C. Service: Equipment will be serviced within 24 hours of equipment failure by a factory-trained service agency. Refrigeration system services shall be available 24 hours per day, seven days per week.

#### 1.07 SUBMITTALS

- A. General: Submit rough-in drawings, custom fabrication drawings and buyout brochure books within 30 days of contract being awarded. Quantity of submittals to be determined by the architect.
  - 1. All submittals will be provided in PDF format. Drawings will also be accepted in AutoCAD compatible format.
  - 2. Architect or GC will forward electronic documents to Foodservice Consultant for review and approval. Foodservice consultant will return all submittals to architect for revisions to be made by the FEC. FEC to make revisions to submittals until all corrections are made. After all corrections are made to the satisfaction of the Foodservice Consultant and Architect submit final documents in quantity required by the architect.
- B. Buyout brochure book: Assemble specification for each piece of foodservice equipment sheets in three-ring binder. Submittal to include numbered cover sheet for each specified item. Indicate accessories and options included with each item. Indicate all utility connections required. Buyout brochure book to be provided in hard copy and PDF format.
- C. Drawings: When required by architect drawings to be sent rolled in a tube. Paper size to be minimum 24" x 36". Drawings to include the following:
  - 1. Layout drawing with equipment list.  $\frac{1}{4}" = 1'-0"$  scale.
  - 2. Dimensioned Mechanical, Electrical and Plumbing rough-in drawings indicating duct locations, rough-in heights, sizes, connection types, drains, electrical outlets, switches, etc.  $\frac{1}{4}" = 1'-0"$  scale.
  - 3. Shop drawings for all custom fabricated equipment in minimum  $\frac{3}{4}" = 1'-0"$  scale. Drawings to indicate Manufacturer and Model for all buyout equipment, metal gauges, types and finishes of all materials used.
- D. Approval: Fabrication may start when approved drawings and buyout brochures are received. Document approval shall not relieve FEC of responsibility to comply with Contract Documents unless prior approval has been obtained by Owner or Architect.
- E. Samples: Samples of materials shall be submitted to Architect for review and approval at no extra cost.
- F. Operations and Maintenance Manuals: Submit PDF copy of operations and maintenance manuals containing all equipment parts lists and operations manuals to Foodservice Consultant for approval. Manuals to include cover sheet indicating project name and location. Cover sheet to include architect contact, foodservice consultant contact and foodservice equipment contractor contact information. Include index indicating all equipment item numbers, manufacturers, serial numbers, responsible service agencies and contact phone numbers. Submit three hard copies in three ring binders to contractor after approval.



## 1.08 PROJECT CONDITIONS AND COORDINATION

- A. Field verify dimensions of foodservice equipment installation areas prior to equipment fabrication.
- B. Coordinate installation requirements for HVAC equipment with GC and MC.
- C. Coordinate fire suppression system components and installation with EC, MC and GC.
- D. Coordinate location and requirements of utility connections with appropriate trades.
- E. Coordinate size, location and requirements for concrete bases, floor depressions and insulated floors with GC.
- F. Coordinate installation of roof curbs, equipment support, roof and wall penetrations with GC.

## PART 2 – PRODUCTS

### 2.01 GENERAL

- A. All equipment and components shall be new and unused.
- B. All items will be the current model at the time of delivery.
- C. All manufacturer items requiring electrical service shall be UL listed, UL approved and labeled with UL symbol.

### 2.02 CUSTOM FABRICATION AND MATERIALS

- A. All custom fabricated equipment as described in Item specifications shall be of identical design and finish and shall be fabricated by one manufacturer. All fabricated equipment is to be labeled with NSF symbol.
- B. Stainless Steel shall be 18-8 Type 304 #4 finish. Sheets shall be of identical color, finish and appearance. Grain of material shall run in same direction whenever possible.
- C. Galvanized steel shall meet ASTM standard A446. Clean, prime and finish with NSF approved grey epoxy-based paint.
- D. Edges, corners and welds shall be ground and polished smooth. No sharp edges will be permitted.
- E. Unless specified the following metal gauges shall be used:
  - 10 Gauge: Gusset Plates
  - 12 Gauge: Hardware reinforcement, channels
  - 14 gauge: Table tops, sinks, backsplashes, drain boards, slanting rack shelves and shelf brackets
  - 16 gauge: Under shelves, over shelves, wall shelves, drawer fronts, access panels
  - 18 gauge: Cabinet bodies, drawer pans, skirts, closure panels, trim strips.
- F. Equipment Edges and Backsplashes: Provide equipment edges and backsplashes shall follow all SMACNA standards unless otherwise noted. Weld and enclose all ends. Cove the intersections of all raised edges and backsplashes  $\frac{3}{4}$ ". Seal all splashes and turn-ups to wall with NSF approved silver silicone.

- G. Sound Dampening: Provide NSF certified 3mm thick sound deadening tape material between table frame and below metal surfaces. NSF approved evenly sprayed-on, 1/8" thick aluminum finish below sinks.
- H. Equipment Tops: Reinforce tops with 1"x 4" 12 gauge stainless steel, welded galvanized or painted angle iron hat channels or u-channels. Provide reinforcement lengthwise and at 30" O.C. and at table legs. Fully weld all intersections. No tack welding of table reinforcement allowed.
- I. Equipment Legs: Provide 1 5/8" O.D. 16 gauge type 304 stainless steel tubing table legs and frames. Continuously weld cross-bracing. Provide S/S flange secured with S/S screws where cross-rails join cabinet body.
- J. Leg sockets: S/S leg sockets with set screws for securing legs. Fully weld leg sockets to channels or socket plates. Legs shall not be placed more than 66" O.C. apart or 30" from front to back.
- K. Cabinet body and semi-enclosed worktables: Provide flush welded mullions. All frame work behind cabinet doors shall be S/S. Provide chases and neatly cut holes for passage of utilities.
- L. Doors: Provide flush mounted welded double pan doors with continuous S/S pull and concealed lift off hinges. Doors shall be 3/4" thick with channel reinforcement and sound dampening core.

Provide Component Hardware #M21-2580 mechanical catches with spring action nylon rollers. Hinged doors are to have heavy-duty lift off hinges and are to be mounted flush with cabinet body.

- M. Drawers: Construct using Component Hardware S52 heavy duty slides, 200# capacity per pair. Provide 3-sided housing mounted to S/S cross bracing mounted to underside of table. Drawer front shall be S/S double pan construction with fiberglass sound dampener and continuous S/S pull. Include Component Hardware rubber cushion bumpers. Weld and silicone 16 gauge S/S pan holder in position. Include removable, stamped 18 gauge, 20" x 20" x 5" pan. Drawers must be self-closing.
- N. Under shelves: Welded under shelves larger than 21" shall be reinforced using same methods as equipment top. Removable shelves shall be no wider than 21". Grind and polish all edges.

Under shelves in cabinet bodies shall have ends and back turned up 1 1/2". Cove intersection minimum 3/4". Weld and seal to cabinet body.

- O. Over shelves: Table over shelves are to be 14" wide mounted on 14 gauge S/S brackets unless otherwise noted. Shelf brackets shall not exceed 48" O.C. Front of table over shelves shall match leading edge of table. "Splash-mounted" over shelves shall be mounted using welded cantilevered 14 gauge S/S supports. Supports to pass through tight-fitting oval holes. Seal holes using NSF approved silver silicone. Cantilevered supports to be bolted to heavy-duty flanges welded to legs or underside of table as indicated on drawings. Shelving supports spaced maximum 60" O.C.
- P. Sinks: Sinks shall be manufactured using 14 gauge S/S. Fully welded one piece construction with 3/4" minimum coved corners. Multiple compartment sinks shall contain fully welded double wall construction. Trim strips not allowed. 18 gauge S/S apron shall be provided in

front of multiple compartments. Bottom of sink to be pitched to center located drain cup. NSF approved sound dampener required on all sinks.

- Q. Drain boards: Pitch all drain boards to sinks.
- R. Equipment Brackets: Provide S/S brackets for all rotary lever drains attached to welded studs and chrome acorn nuts. Fully weld all brackets for disposer controls panels to U-channel reinforcement below table as shown on drawings.
- S. Fasteners: All fastening devices to be unexposed, wherever possible.. Exposed fasteners shall be counter sunk.

## 2.03 EXHAUST HOODS

- A. Provide fully welded all 18 gauge 304 S/S #4 finish on all exposed surfaces. Corners to be fully welded, ground and polished. Ship duct collar loose. Conceal all wiring. Heat sensor to be installed at each duct collar location to activate exhaust fan when cooking occurs below exhaust hood.
- B. Must be designed and installed to comply with all prevailing codes.
- C. Lights to be pre-wired to single electrical connection point for connection by EC. Provide NSF and code compliant light fixtures as specified.
- D. Trim any spaces or gaps between top of exhaust hoods and finished ceiling with matching S/S trim pieces. Channel mounting of trim required. No exposed fasteners.
- E. Hoods to be mounted at 80" AFF.
- F. EC to make any required interconnections between hoods, fans, switches and controls.

## 2.04 COLD STORAGE ROOMS

- A. All construction, components and accessories must comply with the Energy Independence and Security Act – 2009. Include all necessary code complying accessories.
- B. All prefabricated cold storage rooms shall be manufactured by one manufacturer and installed by factory-supervised installer.

- C. Finishes are to be as follows unless otherwise specified.

22 gauge galvalume steel at unexposed walls and ceilings  
.040 stucco aluminum at interior walls and exposed walls  
.040 smooth aluminum with baked-on white finish at ceiling

- D. Interior finished ceiling height shall be 8'-3" unless otherwise specified.

- E. Materials

1. Insulation shall be non-burning urethane, foamed in place.

- a. Insulation shall be fluorocarbon filled (F-11) 95% closed cell content, nominal density of 2.0 pounds  $\pm$  0.1 per cubic foot. Dimensional stability shall be from – 45° F. (+7° C.) to 200° F. (93° C.).

- b. Insulation shall have a thermal conductivity (K-factor) not to exceed (0.14 B.T.U./hour/square foot) as tested on ASTM C-177, at 75° F. (24° C.) mean temperature and an overall coefficient of heat transfer factor (U) not to exceed 0.029.
- c. Classification: Each compartment shall bear a label "Class 1-Insulated Panel" as certified by an independent testing laboratory to have a surface burn spread 25 or less as determined by ASTM E84, UBC No. 8-1, Class A National Fire Protection Association N F P A Number 101, "Life Safety Code".

#### F. Panel Construction

1. Panels shall consist of precision die formed metal pans with ½" (50 mm) to ¾" (76 mm) flanged perimeter, foamed in place urethane insulation between interior and exterior pans, thoroughly checked for gauge and shall be interchangeable with panels of like size. Metal pans shall be treated on the inside with a preparation coating of bonding agent to ensure a stable adhesion with the chemical bonding capabilities of the insulation.
2. Wall and ceiling panels shall be 4" (100 mm) thick and contain 100% foamed in place insulation and shall not have any internal wood or metal structural members. To ensure tight fitting joints, all panel edges shall have foamed in place urethane tongues and grooves and a flexible vinyl gasket foamed in place on the interior and exterior of all edges.
3. Panels shall be rigidly coupled by a cam action hooked locking device. Locking device shall be foamed in place, maximum 48" (1200 mm) on center. Locking device shall be accessible from the inside to facilitate installation in confined areas and shall be provided with caps to close wrench holes. Joints between panels shall be sealed at interior and exterior edges with a PVC gasket or an odorless nontoxic, synthetic polymerized sealant, to maintain continuity.
4. Wall panels shall have a minimum of three (3) locking devices between each panel, located in the center, lower corner and upper corner.
5. Ceiling panels shall have a minimum of two (2) locking devices between ceiling panel and at wall panels, located at each corner of the wall panel. Ceiling panel joints shall be offset from wall panel joints.
6. All interior vertical corners shall be coved with a ½" (12 mm) radius.
7. Exterior panels, interior partitions, corner panels, ceiling panels and "T" intersection panels shall be matching construction.

#### G. Wall/Ceiling Support System

1. Ceiling panels shall have a maximum deflection of 1/240 of the span under uniform loading of twenty (20) pounds per square foot. When the ceiling panels require a support system, the Manufacturer shall submit details and structural calculations to an engineer for approval prior to fabrication. A copy of the approved submittal shall be forwarded to Architect and Consultant.

2. An indoor ceiling panel support system, when required, shall be furnished and installed using a hanger wire network attached to hanger brackets, designed to engage with the female lock pins imbedded within the roof panel foam core, spaced 48" on center.

#### H. Door and Door Frames

1. Door sizes shall be as specified, hinged as indicated on plan. Door shall be able to remain open when opened over 120°.
2. Door shall be flush mounted, in-fitting type with door panel construction to match other panels. Insulation to be same size and type as other panels.
3. Door frames shall be shall consist of vinyl frame with 12 gauge steel frame foamed in place.
4. Door shall be fitted with thermoplastic, magnetic steel core gasket across top and both sides of door. Bottom of door shall be fitted with adjustable, double vinyl wiper gasket. Gasket shall be water, oil, sunlight and fat resistant. When door is in closed position, the magnetic gasket shall form a positive air-tight seal. Door gasket to be easily replaceable.
5. Provide deadbolt locking handle. No exposed fasteners.
6. Provide 16 gauge kick plates or 3/16" diamond tread plate both sides of door to a height of 36" AFF.
7. Provide an anti-condensate heater concealed behind edge of door jam on all sides of frame and below S/S threshold. Heater wires shall be easily accessible for replacement or service.
8. Door shall be adjusted to be self-closing after installation and floor is finished.
9. Provide three hinges on each door.
10. Provide Kason Model 1092 door closer or equal.
11. Provide 12 gauge S/S thresholds at all freezer doors.

#### I. Components and accessories:

All components and accessories shall be provided with conduit, switches, etc. for easy connection by EC and be concealed within cold room wall prior to panel fabrication. Conduit to extend above ceiling panels for connection of electrical by EC.

#### J. Light Fixtures and Switches

1. Provide number of light fixtures as indicated on the electrical rough-in plan.
2. Lights fixtures shall be 48" long LED fixture for walk-in cooler/freezer applications.

#### K. Digital Thermometer and Alarm

1. Digital thermometer and alarm shall be furnished for each cold storage room.
2. Provide all-in-one digital walk-in alarm and light management system. Alarm will contain temperature and door open alarms accessible through one panel interface recessed in wall panel. Provide occupancy sensor with timer pre-set to owner's requirements.
3. When the door does not open into an ambient temperature area, the digital thermometer and alarm shall be factory installed in a wall panel facing an ambient temperature area. Provide name-plate for each thermometer and alarm.

#### L. Door Fan Switch

1. Door fan switch shall be provided for each low-temperature cold storage room, when door opens into a non-refrigerated area, to shut off evaporator coil fan motors when the door is opened.
2. Door fan switch shall be factory mounted on the door jamb and pre-wired with rigid conduit and wiring within the wall panel to a connection point located on the interior of walk-in near the ceiling. Manufacturer shall provide a 1-1/4" hole in ceiling panel with a loose escutcheon plate. EC to connect to the evaporator coil (s) fan motors.

#### M. Closure Panels.

Trim any spaces or gaps between top of cold storage rooms and finished ceiling with matching S/S trim pieces. Channel mounting of trim required. No exposed fasteners.

#### N. Trim

Vertical trim and angles to match cold storage room exterior finish. Trim to be applied with adhesive tape and NSF approved silicone. No exposed fasteners.

#### O. Utility Penetrations

1. Provide openings in ceiling and wall panels to accommodate all electrical, refrigeration and drain lines.
2. Seal all openings with silicone after lines have been run and before installation of escutcheons.

#### P. Escutcheons

1. Provide 5" diameter blank stainless steel escutcheons to trim all interior and exposed exterior penetrations.
2. Provide cutting of proper size hole in blanks and panel penetrations.

#### Q. Pressure Relief Vent

1. Pressure relief vent shall be factory installed at each low-temperature cold storage room door.
2. Pressure relief vent shall be electrically heated, 120 volt and have aluminum screen.

#### R. Corner Guards

Corner guards on the exterior outside corners shall be 3" x 3" x 54" 16 gauge stainless steel secured to wall panels with contact adhesive.

#### S. Bumper Rails

1. Bumper rails when specified shall be located where indicated on plans.
2. Provide vinyl insert wall protectors. Provide aluminum bumper rail track pre-punched on 12" center for field mounting with S/S screws.

#### T. Strip Curtain

Provide NSF approved strip curtain. Strip curtain to be easily replaceable.

#### U. Identification Signs

Provide permanently attached engraved plastic name plates with maximum ¾" high letters identifying each Cold Storage Room and Refrigeration System Compressor. Name plate is to be mounted with adhesive below digital thermometer alarm. A similar name plate with ½" high letters is to be installed on the evaporator coil (s) and at all other items specified with a remote Refrigeration System.

### 2.05 REFRIGERATION SYSTEMS

#### A. COPPER TUBING

1. Refrigerant tubing, manufactured by Anaconda, Phelps Dodge, Cerro, Mueller or approved equal, shall be type K (type L - ACR when permitted by local codes) hard drawn, bright, annealed, dehydrated and sealed tubing. Fitting, elbows and tees shall be sweat type wrought copper. All Elbows are to be Long Radius elbows. Under no circumstances are 45-degree elbows to be used on hot gas defrost systems.
2. All direct buried copper piping is to be type "L" soft copper only, rolled out to be straight and insulated with minimum 1" wall insulation for Low temperature suction, Medium temperature suction and all liquid lines. All underground lines are to be buried within a minimum of a 6" bed of Clean Sand Fill Completely Surrounding the Piping. (No rocks of any size are allowed to be near the piping).

#### B. OVERHEAD PIPING

All overhead piping shall be installed in such a manner as to have relatively easy access in the future for leak checking purpose. Lines above ceiling tile areas are to run in such a way as to be no more than 36" above the ceiling grid line.

#### C. CONDENSATE DRAIN LINE / DRAIN LINE HEATERS:

1. The Refrigeration Contractor shall furnish and install all self-regulating heat tape on all storage freezer(s), and Coolers that operate below a 33 degree room temperature. Refrigeration Contractor to insulate all heat taped drain lines with  $\frac{3}{4}$ " wall insulation.
2. All drain line heat tape is to be self-regulating, 6-watt per foot 120v heat tape, metal covered mesh or wet location heat tape by Frostex or equal will be used. All heat tape is to run on the bottom or down both sides of the pipe and must be secured to the pipe a minimum of every 4". The sealed off end is to be at the evaporator and must hang out 3". The evaporator end is to be stripped back and sealed off with Rached H900 or equal Factory Gel Filled type end cap seal Heat tape is to be connected by the E.C. to a power source is to be located outside of the box. 36" of extra tape outside of the box for the E.C. to connect. All seal off end caps and electrical connect kits are to be supplied by the Refrigeration Contractor. End caps installed by Refrigeration Contractor. Electrical caps installed by E.C.

#### D. INSULATION:

1. All Low Temperature Suction Lines will require (1") Wall Insulation.
2. All Medium Temperature and High Temperature Suction Lines will require ( $\frac{3}{4}$ ") Wall Insulation.
3. All Direct Buried Underground Piping will require (1") Wall Insulation on all Suction and Liquid Lines.
4. Suction line insulation shall start at the evaporator coil outlet and run uninterrupted to the suction line service valve (less suction filter) on a single compressor unit and to the compressor rack suction manifold on a parallel compressor rack. Penetrations at cases or W.I. cooler/freezers are to be spray-foamed and caulked on both sides of penetration. Insulation may be slipped on the tubing or split and then sealed with Armstrong #520 adhesive. Butt joints between sections should be compressed a minimum of 3" per every 6' of insulation. Joints are to be both glued and taped, a minimum of 2" on either side of joints. The contractor will be responsible for repairing separated joints for a period of (one year) after store opening date. Any insulation installed outdoors shall be covered with PVC Jacketing. Liquid and suction lines are not to be insulated together.

#### E. HANGERS AND SUPPORTS:

1. Piping shall be securely supported and anchored with "Unistrut" Channel and "Hydro-Zorb" or SuperStruct" black (only) cushion inserts and steel clamps. Nylon insert lock nuts only shall be used on the clamps. All piping is to be clamped in only one location per straight run. Each turn in direction requires a set of clamps. Provide 12" long galvanized half-moon sleeves to support pipe/insulation at all hanger locations that are not hydrozorb clamped. These cradles are to be glued to the insulation with armax glue covering at least 60% of the cradle (tape is not acceptable to attach metal cradles).
2. Maximum length of a hot or cool gas defrost line set with out or offset is 100'.
3. Maximum length of an off time defrost line set without an offset is 120'.
4. Piping shall be supported at 8' intervals maximum with horizontal corners supported at not more than (12") from each edge of the "bend" fitting. Piping for hot gas defrost and heat reclaim lines should be installed with flexible hangers to permit the free expansion and contraction of the tubing. Supports for unclamped/un-insulated lines shall be



covered with PVC plastic tubing so as to eliminate direct contact between the tubing and the support. On all hangers where Hydro Zorb clamps are used to support the piping. The R.C. is to tape off the bottom of "unistrut" and foam the area under the clamp. Also, a piece of insulation must be then glued over the top of the clamps. All coils are to be hung with 3/8" galvanized rod. 1 5/8" HD green "unistrut" is to be used on the top of all walk-in coolers, walk-in freezer boxes to support the coils. Unistrut must cross cooler lid joints. All coils of over 400 lbs. will require additional support rods attached to the building structural steel.

#### F. BRAZING MATERIALS:

1. A brazing alloy with a minimum of 15% silver content (equal to or exceed Silfos) shall be used on all copper to copper fittings, with the exception of relief valve, vent lines and drain lines. Copper to brass fittings shall be brazed with a minimum of 45% silver content alloy (silver solder). All dissimilar metals shall require 45% silver solder.

#### G. INSTALLATION PROCEDURES

1. All tubing must be kept clean, dry and sealed.
2. The piping shall be laid out and installed to keep the number of fittings at a minimum and the runs as short as possible.
3. Piping shall not run in such a way that might hinder inspection or serviceability of the compressor system.
4. Proper spacing between all line sets to allow for expansion and contraction of lines during gas defrost (minimum 1" spacing).
5. Receiver relief valves on parallel compressor systems shall be piped to the roof. Local codes shall be followed in all other cases (Coordinate with Project Manager before running vent piping).
6. Do not run tubing from one system through a case connected to another system.
7. Refrigeration connections in (Direct Buried) underground locations must be kept to a minimum and all welds must be fully capped with solder.
8. All piping shall be sized by the manufacturer of the equipment. The Refrigeration Contractor shall determine the correct size of all refrigeration piping after verification of job site conditions. Refrigeration Contractor to notify the Manufacturer of any discrepancies. The Manufacturer will make the final determination of sizing of refrigeration piping.
9. Any vertical suction riser shall be trapped at the bottom. Traps are to be either manufactured or double 90-degree elbows and are to be installed the full size of the horizontal run.
10. Piping on hot gas defrost systems shall have a change of direction every 100' (maximum) of straight run to compensate for tubing expansion. Refer to the appropriate compressor system manufacturer's specifications regarding exact sizing and spacing of these "expansion loops".
11. For hot gas defrost systems, multi case systems are to have the suction lines piped in appropriate bull-head tee fashion to ensure even distribution of hot gas during defrost. This practice is to apply, regardless of the compressor system manufacturer's specifications.

The liquid lines must not be bullheaded at any time. Main liquid lines are to be ½" o.d. minimum size and the liquid header line running between cases is to be one size larger than the main liquid line. All liquid line take-offs must come off of the Lower Side of the main liquid line run to assume full column liquid to TXV.

12. Any portion of tubing going through brick, rock or concrete shall be properly sealed and protected to avoid pipe and insulation damage.
13. All capillary tubes are to be topped and wire-tied and/or siliconed to avoid vibration breakage.
14. Before making any final piping connections, all lines are to be blown out with high-pressure dry nitrogen to purge the lines of any loose dirt, filings, scale, etc.

#### H. TESTING AND EVACUATION

1. All refrigeration/heat reclaim and condenser lines are to be pressure tested and leak checked to 200 psi. This pressure must be maintained for 24-hours before attachment to the cases, coils, condensers or racks. After final refrigeration connections are completed, the complete system is to be pressure tested and leak checked at 175 psi.
2. A (Triple) evacuation is to be completed with a two stage vacuum pump and must pull down to 1500 microns on the first evacuation, 600 microns on the second evacuation and 300 Microns or lower on the last evacuation. To break each evacuation the FINAL SYSTEM REFRIGERANT must be used. (Under no circumstance is nitrogen to be used to break an evacuation). (If nitrogen is infused back into the system at any time after evacuations have started the next evacuation is to be considered to be "starting over" at the first evacuation and three additional evacuations must be completed).
3. Final evacuation: The vacuum pump is to be turned off and the system must be capable of rising no higher than the 500-micron level, at a decreasing hourly rate, over a 3 hour period.

#### I. EQUIPMENT START-UP:

1. Check all compressors for proper oil level and, if necessary, add sufficient oil to bring the level to the center of the crankcase sight glass on all units. Use only the refrigeration oil recommended by the compressor manufacturer. All oil must be delivered to the job in factory sealed, unopened containers.
2. Suitable tags or other means (color coding of compressor heads) should be provided to indicate refrigerant type used in each system.
3. Lubricate any motor or other moving parts with the proper oil or grease as necessary.
4. Remove or loosen shipping retainers under motor compressors. Hold down nuts on spring mounted compressors are not to touch the compressor feet, and are not more than 1/16" above the mounting foot.
5. Check high and low pressure control cut-in and cutout points.
6. Charge until system has sufficient refrigerant for proper operation. Do not overcharge. Do not leave compressor unattended until the system is properly charged with refrigerant and oil.

## J. OPERATIONAL CHECKOUT AND CONTROL ADJUSTMENT

1. Thermostatic expansion valves must be checked for proper superheat settings. Feeler bulbs must be in positive contact with the suction line. All valves are to be set per the Manufacturer specifications. If Manufacturer has no specification, use the following guideline:
  - a. Low Temperature Valves: 3° to 5° superheat (average)
  - b. Medium Temperature Valves: 5° to 6° superheat (average)
  - c. High Temperature (A/C): 7° to 8° (average)
  - d. EEV Low Temperature: 8° to 10 degrees (average)
2. All valves are to be set using the Pressure/Temperature method. Temperature/Temperature method is Not Acceptable.

## 2.06 ELECTRICAL REQUIREMENTS

- A. Pre-wiring of electrical equipment shall comply with UL, NEMA, NEC and prevailing codes.
- B. Equipment requiring electrical connections shall be fabricated by UL listed fabricator.
- C. Internal wiring shall be identifiable via tags indicating the item number and electrical requirements. Furnish wiring diagrams. Wiring shall be run in NSF approved rigid conduit. Use chrome where exposed. Wire wet areas in Sealtite EF conduit or equal. Provide raceways for conduit. Final Connections by EC.
- D. Exposed junction Boxes for switches and receptacles shall be S/S or cast aluminum Bell boxes and shall be furnished with S/S cover plates. Provide NEMA water-proof boxes in wet areas.
- E. Provide all code compliant fluorescent tubes and incandescent bulbs required for foodservice equipment.

## 2.07 PLUMBING REQUIREMENTS

- A. All plumbing components and piping shall be lead free and meet or exceed all prevailing codes.
- B. Install piping not less than 6" above finished floor. Whenever possible shall stub-out of walls rather than stub up through floor or using exposed piping. No unnecessary exposed plumbing permitted. No tool marks or visible threads at exposed fittings. Use polished chrome fittings where exposed.
- C. Provide pipe openings, chases and/or punch and cut equipment as required to provide access for Plumbing connections and piping. Work performed at the job site shall be of the same quality as similar work in the shop. Provide close fitting clean cut holes for passage. No sharp edges or non-uniform modifications allowed.
- D. Indirect waste piping (except from sinks and exhaust hoods) shall be installed in accordance with the local codes. Extend piping to a point of at least 2" (50 mm) above hub drain or floor sink and cut bottom on 45° angle. All indirect waste piping shall be installed to ensure proper drainage. Coordinate piping to drain with equipment and building conditions. Secure indirect waste piping to fixture.

- E. Indirect waste piping from ice bins, cold food wells or similar items shall be insulated to prevent condensation.
- F. Water inlets shall be located above the positive water level to prevent siphoning of liquids into the water system. Wherever conditions shall require a submerged inlet. Provide a suitable type of check valve and vacuum breaker.

### **PART 3 - EXECUTION**

#### **3.01 DELIVERY, STORAGE AND HANDLING**

- A. All items shall be delivered, uncrated, assembled and set in place in a safe manner. All items shall be covered at all times, protected and secured until final acceptance. All responsibility shall rest on the contractor for any damage or loss incurred prior to final acceptance.
- B. Contractor to schedule deliveries and movements upon the site to prevent delays in other contractor's work and shall coordinate all on site activities with the General Contractor.
- C. Deliver foodservice equipment as factory-assembled units with protective crating and covering.
- D. Store foodservice equipment in its original crating and protective covering. Store in a dry location.

#### **3.02 FEC INSTALLATION**

- A. FEC to install all items and materials according to Project Schedule.
- B. FEC to furnish all items (brackets, fasteners etc.) required for installation of all specified equipment.
- C. Schedule and coordinate installation with GC and appropriate trades as required.
- D. Provide supervisor during installation to coordinate and inspect the work of other trades related to the installation of foodservice equipment.
- E. Provide all cutting, trimming welding and other modifications required to foodservice equipment.
- F. Uncrate, assemble, set-in place and level all equipment for final utility connections.
- G. Seal and secure all equipment where required.
- H. All wall and ceiling hung items are to be installed and secured by FEC.
- I. Fire suppression systems shall be installed, tested, certified and charged by FEC. EC to connect to electrical and alarm systems where necessary. Exposed fire suppression piping is to be chrome plated.
- J. FEC to assemble all Cold Storage Rooms. Flooring and cove base are by GC unless otherwise specified.
- K. Provide and install complete refrigeration systems fully charged and operational. Provide compressors, condensers, refrigeration rack systems, evaporator coils, vibration eliminators,

sight glasses, expansion valves, filters, oil separators, thermostats, defrost time clocks, defrost heaters, controls, solenoids, liquid line driers and refrigeration grade copper piping and fittings.

- L. Provide all electrical refrigeration components required for electrical connections. EC to wire to connection points.
- M. Install refrigeration components in accordance to manufacturer instructions.
- N. Provide electrical heat tape for freezer condensate lines. Heat tape to be installed by EC.

### 3.03 START-UP AND TESTING

- A. Provide trained individual to start-up and test all items to ensure proper installation and operation of foodservice equipment.
- B. Test and certify all systems as required.
- C. Adjust and calibrate all refrigeration systems, thermostats and temperature readout devices.
- D. Arrange for demonstrations and instructions for operations and maintenance of foodservice equipment. Times and dates are to be selected by the owner. Demonstrations may take place over two days.
- E. Provide operations and maintenance manuals as directed in Submittals section of Section 11 40 00 specifications.

### 3.04 CLEANING

- A. Remove all packing, crating and debris from site.
- B. Remove all protective covering from S/S and other finished surfaces.
- C. Clean finished surfaces, touch up as required and remove or refinish damaged or soiled areas, as acceptable to Architect/Consultant. Clean work surfaces free of smudges, dust and debris.

### 3.05 PROTECTION OF COMPLETED WORK

- A. Provide all necessary protective measures to prevent damage to equipment from exposure to other construction activity.
- B. Advise GC of procedures and precautions for protection of materials and installed Foodservice equipment from damage by work of other trades.

### 3.06 MAINTENANCE

- A. Provide service inspection six months after start-up.
- B. Provide final inspection 30 days prior to the end of warranty periods of equipment. Have all required warranty work completed prior to expiration of warranty.

## **PART 4 – ITEM SPECIFICATIONS**

### **4.01 ROUGH-IN DRAWINGS**

Rough-in drawings have been completed by Capital Foodservice Design. It shall be the responsibility of the Foodservice Equipment Contractor (FEC) to verify all dimensions, plumbing, and electrical services and prevailing codes as they relate to this project and to show any required changes on the documents submitted for approval.

### **4.02 APPROVED FABRICATORS**

Approved fabricators of custom fabricated S/S equipment for this project are.

Best-Way Fabricating, Inc.  
603 19<sup>th</sup> Avenue NE  
PO Box 187  
St. Joseph, MN 56374  
1-800-896-5565

Select Stainless Products  
11145 Monroe Road  
Matthews, NC 28015  
1-888-843-2345

Two Rivers Enterprises  
490 River Street West  
Holdingford, MN 56340  
320-746-3156

Nationwide Fabrication, Inc.  
5311 Niagra Street  
Commerce City, CO 80022  
1-303-853-0107

Institutional Equipment, Inc.  
704 Veterans Parkway, Unit B  
Bolingbrook, IL 60440-5094  
1-630-771-0990

Kiefer Corp.  
400 Industrial Drive  
Random Lake, WI 53075  
1-920-994-4332

### **4.03 ALTERNATES AND SUBSTITUTIONS**

- A. Item specifications are to establish a quality and performance standard. The first manufacturer listed is to be considered prime manufacturer and has been selected to establish a minimum requirement for construction, performance, quality and capacities. Approved alternate manufacturers are listed when available.
- B. Approved alternate manufacturers must provide equipment equal to the prime specified manufacturer. Performance, quality, capacity and accessories must be equal to prime specified manufacturer. FEC to coordinate any changes required to electrical, plumbing or HVAC requirements with Architect, Consultant and appropriate trades. FEC responsible for any cost involved with changes caused by alternate manufacturer selection.

### **4.04 ITEM SPECIFICATIONS**

#### **ITEM 1 SOILED DISH TABLE**

For Informational Purposes Only – Provided by Others

One required

Custom Fabrication

One S/S soiled dish table as shown on drawings. Include the following:

- A. 10" back splash.
- B. Quick drain trough with removable basket.
- C. 20"x20"x10" deep sink.
- D. Removable H-frame.
- E. Provisions for installation of Item 3 disposer.
- F. Weld-on disposer bracket.
- G. Pre-cut holes for spray assembly and vacuum breaker.
- H. Provisions for installation of dishwasher.
- I. Enclosed rolled rim at dishwasher.
- J. Legs with flanged feet as shown on drawings.

ITEM 2 PRE-RINSE SPRAY ASSEMBLY

For Informational Purposes Only – Provided by Others

One required

T&S Brass

One Model B-0133-12ACRB8S.

ITEM 3 DISPOSER

For Informational Purposes Only – Provided by Others

One required

Salvajor

One Model 200-SA-6½"-ARSS-2 (208/60/3) Include the following accessories:

- A. Sink collar assembly.
- B. Chrome Vacuum breaker mounted in angle of backsplash.
- C. Solenoid valve.
- D. Flow control valve.

ITEM 4 DISHWASHER

For Informational Purposes Only – Provided by Others

One required

Hobart

One Model PW20. Include the following:

- A. Vent fan assembly.
- B. Pressure regulator valve.

ITEM 5 S/S WALL COVERING

For Informational Purposes Only – Provided by Others

Lot required

Custom Fabrication

20 ga. #4 finish S/S panels along the full length of the wall behind dish tables, dishwasher, three compartment sink and full wall at right end of three compartment sink. The paneling shall extend from the top of the flooring base material to finished ceiling. Joints between the panels shall be covered with Component Hardware Model J64-1450 AH strips. Seal the panels with clear silicone. All panels shall be securely attached with clear silicone on the full perimeter of each panel and at rear surfaces.

ITEM 6 3-COMPARTMENT SINK/CLEAN DISH TABLE

For Informational Purposes Only – Provided by Others

One required

Custom Fabrication

One set of S/S utensil sinks. Include the following:

- A. Three 20" x 28" x 14" deep sinks.
- B. Three Component Hardware DBN-8000 rotary drains.
- C. Welded on rotary drain brackets.
- D. 10" high back splash and right end splash.
- E. One T&S Model B-0290 "Big-Flo" faucet..
- F. Sectional removable under shelves as shown on drawings.
- G. Enclosed rolled rim at dishwasher.
- H. Provisions for installation of dishwasher.

ITEM 7 SPRAY AND FILL ASSEMBLY

For Informational Purposes Only – Provided by Others

One required

T&S, Fisher or Chicago Faucet equal Model

One Model B-0287 "Big-Flo" spray and fill assembly.

ITEM 8 HAND SINK

For Informational Purposes Only – Provided by Others

One required

Advance Tabco

One Model 7-PS-62 hand sink with knee operated faucet.

ITEM 9 WALL SHELF/POT RACK

For Informational Purposes Only – Provided by Others

One required

Advance Tabco or Custom Fabricated equal

One Model PS-15-36.

ITEM 10 MOBILE HEATED CABINETS

For Informational Purposes Only – Provided by Others

Two required

Intermetro

Two Model C539-HDC-U with flush door latch.

ITEM 11 MOBILE SHELVING

For Informational Purposes Only – Provided by Others

Six required

Focus, Eagle or InterMetro approved equal Model

Three shelving units consisting of the following:

- A. Five FF2148GN shelves.
- B. Four FGN063GN posts.
- C. Four FSCAST5B casters.

Three shelving units consisting of the following:

- A. Five FF2160GN shelves.
- B. Four FGN063GN posts.
- C. Four FSCAST5B casters.

ITEM 12 HAND SINKS

For Informational Purposes Only – Provided by Others

Two required

Advance Tabco

Two Model 7-PS-62 hand sink with knee operated faucet.

ITEM 13 OPEN NUMBER

ITEM 14 WORK TABLE WITH SINKS

For Informational Purposes Only – Provided by Others

One required

Custom Fabrication

One stainless steel work table with sinks as shown on drawings. Include the following:

- A. Two 20" x 20" x 12" deep sinks with drain overflows. Provide one-piece front panel.
- B. Component Hardware DBN-8015 rotary drain.
- C. E50-1000 over flow assembly at disposer sink.
- D. Provisions for installation of faucet and vacuum breaker and disposer.
- E. Welded disposer control bracket and rotary drain bracket.
- F. 8" back splash.
- G. Raised rail edge.
- H. Partial sectional removable under shelves.



ITEM 15 SPRAY AND FILL ASSEMBLY

For Informational Purposes Only – Provided by Others

One required

T&S Brass

One Model B-0133-12ACRB8S.

ITEM 16 DISPOSER

For Informational Purposes Only – Provided by Others

One required

Salvajor

One Model 200-SA-6½"-ARSS-2 (208/60/3) Include the following accessories:

- A. Sink collar assembly.
- B. Chrome Vacuum breaker mounted in angle of backsplash.
- C. Solenoid valve.
- D. Flow control valve.

ITEM 17 WALL SHELVES

For Informational Purposes Only – Provided by Others

Four required

Custom Fabrication

Four 12"x36" stainless steel wall shelves as shown on drawing.

ITEM 17.1 WIRE WALL SHELVES

For Informational Purposes Only – Provided by Others

Lot required

Focus Foodservice

Three Model FF1448GN shelves. Include the following:

- A. Two FWB14SG direct mount wall brackets.
- B. Two FWB14DG direct mount wall brackets.

ITEM 18 WALL SHELF

For Informational Purposes Only – Provided by Others

One required

Advance Tabco or Custom Fabricated equal

One Model MS-1824.

ITEM 19 S/S WALL COVERING

For Informational Purposes Only – Provided by Others

Lot required

Custom Fabrication

20 ga. #4 finish S/S panels along the full length of the wall. The paneling shall extend from the top of the flooring base material to bottom edge of the hood. Joints between the panels shall be covered with Component Hardware Model J64-1450 AH strips. Seal the panels with clear silicone. All panels shall be securely attached with clear silicone on the full perimeter of each panel and at rear surfaces.

ITEM 20 WORK TABLE

For Informational Purposes Only – Provided by Others

One required

Custom Fabrication

One 36" x 24" S/S mobile worktable. Include the following:

- A. Full under shelf.
- B. Four Colson or Jarvis equal #22.0657.95 TotalLock swivel stem casters.

#### ITEM 21 IMPINGER OVEN

For Informational Purposes Only – Provided by Others

One required

Lincoln

One Model 1116-xxx-U. Include the following:

- A. FastBake.
- B. Right to left operation.
- C. Mobile stand.
- D. Dormont or equal gas hose with swivels at both ends and quick disconnect and restraining cable.

#### ITEM 22 CHAR-BROILER

For Informational Purposes Only – Provided by Others

One required

Baker's Pride

One Model F-72R. Include the following:

- A. Heavy-duty casters.
- B. Overhead back shelves with additional grates.
- C. Dormont or equal gas hose with swivels at both ends and quick disconnect and restraining cable.

#### ITEM 23 EXHAUST HOOD

One required

Accurex, Avtec or Gaylord approved equal Model;

One Model XBEW-T 15-0" x 63" x 24" tapered exhaust hood. Exhaust hood shall be all 300 series S/S. Include equal sized removable filter cartridges 16" max width and S/S filter removal tool. The hood shall be fabricated in two equal sections if required by delivery access.

Hoods shall be U.L. listed and NSF approved. Exhaust hoods shall meet all requirements of NFPA-96 and be IMC 507.2.1.1 compliant.

Include the following:

- A. LED lights pre-wired to single connection point.
- B. Pre-piping for fire suppression system.
- C. Matching S/S trim from top of hood to finished ceiling. Use channel mounting. No exposed fasteners permitted.
- D. Factory mounted 3" back air space.
- E. Performance enhancing lip.
- F. Sloped grease trough with removable enclosed grease cup.
- G. Temperature Interlock Switch.

#### ITEM 24 FIRE SUPPRESSION SYSTEM

One required

Ansul

One Model R-102 wet chemical fire suppression system mounted in stainless steel cabinet as shown on drawings. Pre-piping provided by exhaust hood manufacturer. Provide chrome nozzle drops. Provide duct and surface protection all electrical connections below exhaust hood. Provide mechanical gas shut-off valve and remote pull switch to appropriate trades for installation.

ITEM 25 PASS-THROUGH FREEZER

For Informational Purposes Only – Provided by Others

One required

Continental, Hoshizaki or approved equal

One Model 1FS-SA-HD. Include the following:

- A. Pass-through.
- B. Two additional shelves.
- C. Doors hinged as shown on drawings.
- D. Expansion valve system.

ITEM 26 WORK TABLE

For Informational Purposes Only – Provided by Others

One required

Custom Fabrication

One 9'-0" x 30" S/S work table. Include the following:

- A. Component Hardware S90-0020-CN drawer.
- B. Full under shelf as shown on drawings.
- C. Legs and cross rails as shown on drawings.

ITEM 27 PASS-THROUGH REFRIGERATOR

For Informational Purposes Only – Provided by Others

One required

Continental, Hoshizaki or approved equal

One Model 1RS-SA-HD. Include the following:

- A. Pass-through.
- B. Two additional shelves.
- C. Doors hinged as shown on drawings.
- D. Expansion valve system.

ITEM 28 GRIDDLE

For Informational Purposes Only – Provided by Others

One required

Baker's Pride

One Model BPHMG-2448i. Include the following:

- A. Stainless steel equipment stand with locking casters.
- B. Stainless steel front mounted work deck.
- C. Dormont or equal gas hose with swivels at both ends and quick disconnect.

ITEM 29 CONVECTION OVENS

For Informational Purposes Only – Provided by Others

One stack of two required

Baker's Pride

One Model BCO-G2. Include the following:

- A. (2) additional oven racks.
- B. Heavy-duty short casters.
- C. Dormont or equal gas hoses with swivels at both ends and quick disconnect and cable restraints.

### ITEM 30 FRY DUMP TABLE

For Informational Purposes Only – Provided by Others

One required

Custom Fabrication

One 36" x 18" S/S mobile worktable. Include the following:

- A. Full under shelf.
- B. Four Colson or Jarvis equal #22.0657.95 TotalLock swivel stem casters.

### ITEM 31 FRYERS

For Informational Purposes Only – Provided by Others

Three required

Avantco

Three Model FF400 fryers. Include the following:

- A. Casters.
- B. Dormont or equal gas hose with swivels at both ends and quick disconnect and restraining cables.

### ITEM 32 EXHAUST HOOD

One required

Accurex, Avtec or Gaylord approved equal Model;

One Model XBEW-T 15-0" x 63" x 24" tapered exhaust hood. Exhaust hood shall be all 300 series S/S. Include equal sized removable filter cartridges 16" max width and S/S filter removal tool. The hood shall be fabricated in two equal sections if required by delivery access.

Hoods shall be U.L. listed and NSF approved. Exhaust hoods shall meet all requirements of NFPA-96 and be IMC 507.2.1.1 compliant.

Include the following:

- A. LED lights pre-wired to single connection point.
- B. Pre-piping for fire suppression system.
- C. Matching S/S trim from top of hood to finished ceiling. Use channel mounting. No exposed fasteners permitted.
- D. Factory mounted 3" back air space.
- E. Performance enhancing lip.
- F. Sloped grease trough with removable enclosed grease cup.
- G. Temperature Interlock Switch.

### ITEM 33 FIRE SUPPRESSION SYSTEM

One required

Ansul

One Model R-102 wet chemical fire suppression system mounted in stainless steel cabinet as shown on drawings. Pre-piping provided by exhaust hood manufacturer. Provide chrome nozzle drops. Provide duct and surface protection all electrical connections below exhaust hood. Provide mechanical gas shut-off valve and remote pull switch to appropriate trades for installation.

### ITEM 34 MOP SINK

For Informational Purposes Only – Provided by Others

One required

Advance Tabco or equal

One Model 9-OP-40DF. Include T&S Model B-0655-BSTP faucet.

ITEM 35 S/S WALL COVERING

For Informational Purposes Only – Provided by Others

Lot required

Custom Fabrication

Provide 18 gauge #4 finish S/S panels at mop sink as shown on drawings. S/S panels to extend 24" past edge of mop sink where possible. Panels to be 48" tall. Provide S/S corner, edge and top molding. Seal the panels using NSF approved clear silicone. All panels shall be securely attached with clear silicone along the full perimeter of each panel and on the rear of S/S panel to ensure a tight and secure installation of the S/S panels to the walls.

ITEM 36 ICE MAKER WITH BIN

For Informational Purposes Only – Provided by Others

One required

Hoshizaki, Manitowoc or Scotsman approved equal

One Model KM-1100MAH. Include the following:

- A. Model B-700SF bin with top kit.
- B. Bin control with bin control extender.
- C. 3M or approved equal water filtration system.

ITEM 37 FLOOR TROUGH

One required

Custom Fabrication, Advance Tabco or Eagle approved equal Model

Furnish one 12 gauge S/S floor trough as shown on Drawings. Provide to GC for early installation.

Include perforated removable scrap basket for 3" drain. Coordinate installation with GC and PC.

Include 1" thick FRP reinforced fiberglass grate with 1" x 4" rectangular grid with non-skid surface.

Do not use fiberglass rod for tie-bars.

ITEM 38 OPEN NUMBER

ITEM 39 OPEN NUMBER

ITEM 40 WALK-IN COOLER

One required

Kolpak, Master-Bilt or Leer approved equal Model

- A. General: One assembly of prefabricated panels fabricated according to NSF Standard #7 and Section 11400.
- B. Dimensions: Overall dimensions to be approximately 20'-2" x 22'-2" x 9'-2", flat bottom wall panels set in U-shaped screed anchored to the floor using non-corrosive anchors. Include column notch as shown on drawings. GC to provide 7" deep smooth and transit level recess. GC to provide rigid foam insulation, vapor barrier, sub floor, finished flooring material and coved base on the interior and exposed exterior of the box.
- C. Metal Finishes:
  1. 26 gauge galvalume steel at unexposed walls and ceilings.
  2. .040 stucco aluminum at interior walls and exposed walls.
  3. .040 smooth aluminum with baked-on white finish at ceiling.
  4. .063 aluminum diamond tread wainscot where exposed.
- D. Trim: Trim the box to the walls and finished ceiling using matching stucco aluminum. Top trim panels to be channel mounted. Verify finished ceiling height. No exposed fasteners allowed. Furnish and install a bumper rail with vinyl insert at all exposed exterior walls. Omit bumper rail from doors.
- E. Doors: (1) 34" x 78" with 14"x14" heated view port.  
(1) 42" x 78" with 14"x14" heated view port

- F. Lighting: LED door assembly light fixture mounted above door. Provide 48" LED light fixtures suitable for walk-in cooler and freezer applications. Light level minimum 20 foot candles.
- G. Temperature Alarms: Digital walk-in alarm and light management system.  
Temperature probe and cord mounted minimum 72" from walk-in door.  
Alarms to be completely installed and set to notify user at:
  - 1. +35° F and +48° F for the cooler.
  - 2. +15° F for the freezers.
- H. Refrigeration Systems: Provide complete remote refrigeration systems. Include the following:
  - 1. Welded angle iron frame to mount the condensing unit for Item #40. Verify the exact location and installation methods with the GC.
  - 2. ArcticFox controller.
  - 3. One scroll PC2968MZOP-3 3 hp air-cooled condensing unit and Model AM26-117-1EC-PR-8 evaporator coil air defrost with R-448a refrigerant for the walk-in cooler Item 40. Include crankcase heater for -20° ambient conditions and weather-proof housing.
  - 4. Master controller for walk-in cooler and freezer boxes.
  - 5. Installed line driers, sight glasses, vibration eliminators.
  - 6. Installation procedures to follow Section 11400 Refrigeration Systems Specifications.

#### ITEM 41 BEER DISTRIBUTION SYSTEM

For Informational Purposes Only – Provided by Others

One required

Perlick

Contact Specialized Marketing - (262) 798-1533 for all required installation additional installation supplies required for installation.

- A. 2 ea 4414-230-3 Draft Beer System Power Pak, air-cooled, 26-3/4"W x 20-1/4"D x 31"H, (3) 100 gph circulating pumps, 1.75 gallon capacity glycol bath, constant pressure expansion valve, adjustable electronic temperature control with digital readout, stainless steel cabinet, R134a, 3/4 HP, 208/230v/60/1-ph, 16.1 amps, cULus, NSF.
- B. 5 yr. compressor warranty, 1 yr. parts & labor warranty.
- C. Second year extended parts & labor warranty for refrigeration products.
- D. Installation of Century Beer System to include start up.

#### ITEM 42 COOLER/FREEZER SHELVING

For Informational Purposes Only – Provided by Others

Twenty-Five required

Focus, InterMetro or Olympic approved equal Model

Twelve shelving units each consisting of the following:

- A. Five FF2160GN shelves.
- B. Four FGN074GN posts.

Seven shelving units each consisting of the following:

- A. Five FF2148GN shelves.
- B. Four FGN074GN posts.

One shelving unit consisting of the following:

- A. Five FF2460GN shelves.
- B. Four FGN074GN posts.

Four shelving units each consisting of the following:

- A. Five FF2448GN shelves.
- B. Four FGN074GN posts.

One shelving consisting of the following:

- A. Five FF2436GN shelves.
- B. Four FGN074GN posts.

#### ITEM 43 COOLER/FREEZER DUNNAGE RACKS

For Informational Purposes Only – Provided by Others

Three required

Focus Foodservice, New Age or Channel approved equal Model

Three Model FHADR482012 48" x 20" x 12" heavy-duty aluminum dunnage racks.

#### ITEM 44 WALK-IN FREEZER

One required

Kolpak, Master-Bilt or Leer approved equal Model

- A. General: One assembly of prefabricated panels fabricated according to NSF Standard #7 and Section 11400.
- B. Dimensions: Overall dimensions to be approximately 8'-8" x 14'-5" x 9'-2", include 25" x 25" notch as shown on drawings, flat bottom wall panels set in U-shaped screed anchored to the floor using non-corrosive anchors. Include column notch as shown on drawings. GC to provide 7" deep smooth and transit level recess. GC to provide rigid foam insulation, vapor barrier, sub floor, finished flooring material and coved base on the interior and exposed exterior of the box.
- C. Metal Finishes:
  - 1. 26 gauge galvalume steel at unexposed walls and ceilings.
  - 2. .040 stucco aluminum at interior walls and exposed walls.
  - 3. .040 smooth aluminum with baked-on white finish at ceiling.
- D. Trim: Trim the box to the walls and finished ceiling using matching stucco aluminum. Top trim panels to be channel mounted. Verify finished ceiling height. No exposed fasteners allowed. Furnish and install a bumper rail with vinyl insert at all exposed exterior walls. Omit bumper rail from doors.
- E. Doors: 34" x 78" with 14"x14" heated view port.
- F. Lighting: LED door assembly light fixture mounted above door. Provide 48" LED light fixtures suitable for walk-in cooler and freezer applications. Light level minimum 20 foot candles.
- G. Temperature Alarms: Digital walk-in alarm and light management system. Temperature probe and cord mounted minimum 72" from walk-in door. Alarms to be completely installed and set to notify user at:
  - 1. +35° F and +48° F for the cooler.
  - 2. +15° F for the freezers.
- H. Refrigeration Systems: Provide complete remote refrigeration systems. Include the following:
  - 1. Welded angle iron frame to mount the condensing unit for Item #44. Verify the exact location and installation methods with the GC.
  - 2. ArcticFox controller
  - 3. One scroll PC298LZOP-3E 3 hp air-cooled condensing unit and Model EL26-077-1EC-PR-8 evaporator coil electric defrost with R-448a refrigerant for the walk-in freezer Item 44. Include crankcase heater for -20° ambient conditions and weather-proof housing.
  - 4. Master controller for walk-in cooler and freezer boxes.
  - 5. Installed line driers, sight glasses, vibration eliminators.
  - 6. Installation procedures to follow Section 11400 Refrigeration Systems Specifications.

ITEM 45 WALL CAPS

For Informational Purposes Only – Provided by Others

Six required

Custom Fabrication

Six 18 gauge stainless steel wall caps as shown on drawings. Verify finished ceiling height. Protectors are to extend upward from the top of the cove base and are to be attached with round head screws and clear silicone. All edges are to be sealed with silicone.

ITEM 46 STAINLESS STEEL BEVERAGE CHASES

For Informational Purposes Only – Provided by Others

Four required

Custom Fabrication

Four 18 gauge stainless steel chases with removable covers for passage of soda and beer distribution lines. Coordinate size requirements with soda system supplier and Perlick Beer system installer. Coordinate installation requirements with GC and serving counter manufacturer.

ITEM 47 OPEN NUMBER

ITEM 48 SODA DISTRIBUTION SYSTEM

Provided by Vendor. Not in Contract.u

ITEM 49 WORK TABLE

For Informational Purposes Only – Provided by Others

One required

Custom Fabrication

One S/S work table with sink as shown on drawings. Include the following:

- A. 8" back splash and left end splash.
- B. Component Hardware S90-0020-CN drawer.
- C. Full under shelf.
- D. Legs and cross rails as shown on drawings.

ITEM 50 WALL SHELVES

For Informational Purposes Only – Provided by Others

Two required

Custom Fabrication

One 72" x 14" S/S wall shelves as shown on drawings.

ITEM 51 PASS-THROUGH HEATED CABINET

For Informational Purposes Only – Provided by Others

One required

Continental or approved equal

One Model DL1WE-SA-PT. Include half doors hinged as shown on drawings.

ITEM 52 PASS-THROUGH HEATED CABINET

For Informational Purposes Only – Provided by Others

One required

Continental or approved equal

One Model DL1WE-SA-PT. Include half doors hinged as shown on drawings.

ITEM 53 OPEN NUMBER

ITEM 54 OPEN NUMBER



ITEM 55 COLD TOP REFRIGERATOR

For Informational Purposes Only – Provided by Others

One required

Continental or approved equal

One Model DL48-12. Include the following:

- A. Double over shelves.
- B. Front breathing.
- C. Expansion valve system.
- D. Door locks.
- E. Casters.

ITEM 56 BEVERAGE REFRIGERATORS

For Informational Purposes Only – Provided by Others

Two required

True, Beverage Aire or approved equal

Two Model GDM-23-HC-LD. Include the following:

- A. Black aluminum interior with black shelving.
- B. 2 ½" casters.
- C. Gravity feed organizers.

ITEM 57 FOOD WARMERS

For Informational Purposes Only – Provided by Others

Six required

Vollrath or approved equal

Six Model 72000.

ITEM 58 HEAT LAMPS

For Informational Purposes Only – Provided by Others

Two required

Hatco

Two Model GRAH-48. Include the following:

- A. 16" T-leg stand.
- B. Attached 6' cord and plug set.

ITEM 59 CHEESE DISPENSER

For Informational Purposes Only – Provided by Others

One required

Hatco

One Model FST-1-MN.

ITEM 60 POPCORN MAKER

For Informational Purposes Only – Provided by Others

One required

Gold Medal

One Model 2552-00-001- PopMaxx with Power Off.

ITEM 61 P.O.S. STATIONS

Provided by Operator. Not in Contract.

**ITEM 62 BEER DISPENSERS**

For Informational Purposes Only – Provided by Others

Two required

Perlick

Two Model 4006S12B. Include the following:

- A. (2) C18660 C18000 Series Drip Tray Trough, surface mount, 46-9/16"W x 7-3/4"D, bevel edge, removable louvered glass rack, 1/2" drain, stainless steel construction.
- B. NSF Faucets.
- C. Beer faucet locks.

**ITEM 63 SODA DISPENSERS**

Provided by Vendor. Not in Contract.

**ITEM 64 BEER DISPENSERS**

For Informational Purposes Only – Provided by Others

Two required

Perlick

Two Model 4006-4B. Include the following:

- A. C18645A C18000 Series Drip Tray Trough, surface mount, 20-3/4"W x 7-3/4"D, bevel edge, removable louvered glass rack, 1/2" drain, stainless steel construction
- B. NSF Faucets.
- C. Beer faucet locks.

**ITEM 65 SERVING COUNTERS**

Provided by Others. Not in Contract.

## SECTION 12 36 16

### METAL COUNTERTOPS

#### 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 stainless-steel countertops.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver metal countertops only after casework has been completed in installation areas.
- B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

##### 1.5 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction to receive metal countertops by field measurements before fabrication.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- B. Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that complies with applicable requirements in Section 07 92 00 "Joint Sealants."

1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, non-sag, acid curing, silicone.
2. Joint Sealant: silicone; Class 25.
3. Color: Clear.

## 2.2 STAINLESS-STEEL COUNTERTOPS

- A. Countertops: Fabricate from 0.062-inch- (1.59-mm-) thick, stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and end overhang of 1 inch (25 mm) over the base cabinets.
  1. Joints: Fabricate countertops in sections for joining in field.
  2. Weld shop-made joints.
  3. Sound deaden the undersurface with heavy-build mastic coating.
  4. Extend the top down to provide a 1-inch- (25-mm-) thick edge with a 1/2-inch (12.7-mm) return flange.

## 2.3 STAINLESS-STEEL FINISH

- A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.
- B. Field Jointing: Where possible, make field jointing in the same manner as shop jointing; use fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
- C. Secure tops to half-wall with Z- or L-type fasteners or equivalent; use two or more fasteners at each front, end, and back.
- D. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.

- E. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

### 3.3 CLEANING AND PROTECTION

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over the countertop surfaces. Tape to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION



## SECTION 12 36 61

### SOLID SURFACING COUNTERTOPS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:

- 1. Solid surface material countertops.

- B. Related Requirements:

- 1. Section 11 40 00 "Foodservice Equipment" for items, power supply and supply lines, waste lines to be connected to or through countertop.

##### 1.3 SUBMITTALS

- A. Product Data: For countertop materials.

- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

- 1. Show locations and details of joints.
  - 2. Show direction of directional pattern, if any.

- C. Samples: For the following products:

- 1. Countertop material, 6 inches (150 mm) square.
  - 2. Wood trim, 8 inches (200 mm) long.
  - 3. One full-size solid surface material countertop, with front edge, 8 by 10 inches (200 by 250 mm), of construction and in configuration specified.

- D. Qualification Data: For fabricator.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.

#### 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

#### 1.7 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

### PART 2 - PRODUCTS

#### 2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
  - 1. Acceptable Manufacturers:
    - a. Avonite Surfaces, Acrylic Solid Surface
    - b. DuPont, Corian
    - c. Vendura, Acrylic Solid Surface
    - d. Wilsonart, Acrylic Solid Surface
  - 2. Type: Provide Standard type.
  - 3. Colors and Patterns: As selected by Architect from manufacturer's full range.
- B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

#### 2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WT's "Architectural Woodwork Standards."



1. Grade: Premium.
- B. Configuration:
1. Front: Straight, slightly eased at top.
  2. Backsplash: None.
  3. End Splash: Straight, slightly eased at corner.
- C. Countertops: 1/2-inch- (12.7-mm-) thick, solid surface material with front edge built up with same material.
- D. Endsplashes: 1/2-inch- (12.7-mm-) thick, solid surface material.
- E. Fabricate tops with shop-applied edges and endsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
1. Fabricate with loose backsplashes for field assembly.
  2. Install integral sink bowls in countertops in the shop.
- F. Joints: Fabricate countertops without joints.
- G. Joints: Fabricate countertops in sections for joining in field.
1. Joint Locations: Not within 18 inches (450 mm) of a sink or cooktop and not where a countertop section less than 36 inches (900 mm) long would result, unless unavoidable.
  2. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.
- H. Cutouts and Holes:
1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
    - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.
    - b. Provide vertical edges, rounded to 3/8-inch (10-mm) radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch (5 mm) into fixture opening.
    - c. Provide 3/4-inch (20-mm) full bullnose edges projecting 3/8 inch (10 mm) into fixture opening.
  2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

## 2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.

- B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.
- B. Fasten countertops by screwing through subtops into metal wall brackets. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
  - 1. Install metal splines in kerfs in countertop edges at joints[ **where indicated**]. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
  - 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- F. Install end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
  - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

H. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION



## SECTION 13 34 16

### BLEACHERS

#### PART 1 - GENERAL

##### 1.1 SCOPE OF WORK

- A. Extent of replacement and new elements is indicated on the Drawings.
- B. Provide all labor, materials and equipment required for complete installation.
- C. New work shall match existing.

##### 1.2 SUMMARY

- A. This Section includes prefabricated guardrails and handrails, new metal ramp and all necessary anchors and miscellaneous metals.
- B. Related Sections include the following:

##### 1.3 SUBMITTALS

- A. Submit the following to the Owner / Architect:
- B. Samples of:
  - 1. Handrail support post and cap for each installation type.
  - 2. 12"x12" sample of chain link
  - 3. Stair rails.
  - 4. Ramp components.
- C. Layout plan indicating aisles, aisle handrails, walkway, seating sections and exits.
- D. Calculations by a registered engineer showing the deviations meet or exceed the specified item they are intending to replace.
- E. Schedule of work experience, including names of contacts and phone numbers – 10 jobs minimum.
- F. List of (3) similar jobs – should the Owners request a site visitation to these jobs, it will be at the bidder's expense.
- G. Project schedule, including phasing with other trades and designation for all tasks, milestone dates for drawing submittal, fabrication time, key material delivery dates and designated dates of installation.

#### 1.4 DESIGN CRITERIA

- A. All material and workmanship shall be in accordance with the following:
  - AISC Manual of Steel Construction, Ninth edition, 1989.
  - Building Code Requirements for Structural Concrete (ACI 318)
  - Aluminum Association of America
- C. Design Load (Guardrail System)
  - Per Wisconsin Enrolled Commercial Building Code.
- D. Code Compliance – All work shall comply with current codes.
- E. General – The seats and guardrails shall be of adequate size to carry required loads.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer: company specializing in spectator seating with a minimum of ten (10) years of experience in manufacturing bleacher seating.
- B. Engineer Qualifications: The renovation of the grandstand seating and handrails shall be under the supervision of, and approved by a registered professional engineer and all submittal drawing shall bear his stamp.
- C. Warranty: Bleachers shall be guaranteed for one (1) year against defective material or workmanship. Damage resulting from abnormal use, vandalism, or incorrect installation (if done by other than an installer of the manufacturer) is not applicable.
- D. Detailed Certificate of Insurance, including products/completed operations liability insurance, shall be provided.

### PART 2 - GENERAL

#### 2.1 ACCEPTABLE MANUFACTURER

- A. Dant Clayton Corp. P.O. Box 4520, Parker, CO 80134, tel: (303) 940-8999, fax (502) 214-8709.
- B. Steel Structures, 4688 Hwy 16 South, P.O. Box 2048 Graham, Texas 76450
- C. Approved Equal.

#### 2.2 PRODUCTS

- A. Materials:

B. Guardrail Systems:

1. Rails shall be of anodized aluminum extruded pipe 6061-T6 alloy, 1 5/8" o.d.
2. Handrail supports shall be aluminum channel 3" x 1.438" x .188" and shall be 6061-T6 alloy.
3. Grabrails shall be extruded aluminum pipe of 6063-T5 alloy, 1 15/16" o.d.
4. Chain link fence shall be 2" mesh, 9 gauge galvanized fabric.

C. Extrusions:

1. Bench seats shall be with powder coated paint finish.
2. Support brackets shall be 6063-T6 extruded aluminum and shall be mill finishes. Brackets shall be of such a design to allow a maximum of 17" rise from the foot tread to the seat.

D. Ramps and Ramp Platforms

1. Ramps shall be 9"x1.40 extruded aluminum mill finish channel with 3" x 1.4" extruded aluminum mill finish vertical channel columns.
2. Planks of ramp shall be installed with fluted surface perpendicular to the path of egress.

E. Hardware & miscellaneous metals:

1. Bolts used for field installation shall be hot dipped galvanized after fabrication.
2. End Caps:
  - a. Seatboard shall be cast aluminum, friction fit.
  - b. Handrail post shall be capped with a cast aluminum cap.
3. Provide all miscellaneous metals required for completion of work.

## 2.3 COMPONENTS

- A. Handrail system at the front and sides of the grandstand shall consist of rails with chain link fence.
- B. Handrail systems for concrete ramps and stairs shall have handrails on both sides.
- C. Ramp system shall include supports, platforms, ramp, handrails, chain link fence, and connection to concrete.
- D. New accessible entrance ramp shall have metal handrail.

## PART 3 - EXECUTION

### 3.1 FIELD VERIFICATION

- A. Extent of work is as indicated on the drawings; however field verification of quantities, sizes, profiles, materials and finishes by Contractor is required.

### 3.2 INSTALLATION

- A. General. Install replacement components utilizing details identical to and/or compatible with existing installations. Refer questionable details to the Architect for verification prior to installation.
- B. Installation. Shall be handled directly by the manufacturer or by a factory certified installation subcontractor.
- C. Expansion anchors will not be allowed.

### 3.3 CLEAN UP

- A. Clean all surfaces according to manufacturer's recommendations. by manufacturer.
- B. Clean up all debris caused by work of this section. Contractor is responsible for cleaning and legally disposing of all debris.

END OF SECTION



**SECTION 21 05 00  
COMMON WORK RESULTS FOR FIRE SUPPRESSION**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: It is the intent of these specifications to provide complete and workable fire suppression systems as shown on the accompanying Plumbing Drawings and as specified herein except such parts as are specifically exempted herein. Provide all necessary supervision, coordination, labor, materials, equipment, fixtures, drayage, hoisting, tools, transportation, plant services and facilities, machinery and connections to utilities for the installation of complete and operable fire protection systems. If details or special conditions are required in addition to those shown on drawings, provide all material and equipment usually furnished with such systems or required to complete their installation, whether noted in plans and specification or not.
- B. Materials and labor shall be new (unless noted otherwise), first class and workmanlike and shall be subject at all times to the A/E's inspections, tests and approval from the commencement until the acceptance of the completed work.
- C. The layout shown on the drawings is necessarily diagrammatic but shall be followed as closely as other work will permit. The drawings provide design intent. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.
- D. Because of the scale of the drawings, certain basic items, such as, pipe fittings, access panels, and sleeves, may not be shown. Where such items are required by Code or by other Sections, or where required for proper installation of the Work, such items shall be included, whether shown or not.
- E. In the event of any inconsistencies between the specifications, drawings, contract documents, applicable laws, statutes, ordinances, building codes, rules and regulations, the contractor shall provide the better quality or greater quantity of work and comply with or conform its work to the most stringent legal or contractual requirements.
- F. Changes from these drawings required to make this work conform to the building construction shall be made only with prior written approval of the Architect/Engineer. All proposed changes shall be shown on shop drawings. All measurements shall be verified by actual observation and all work shall fit in place meeting the approval of the Architect/Engineer.
- G. Equipment specification may not deal individually with minute items required, such as components, parts, controls, and devices which may be required to produce the equipment performance specified or as required to meet the equipment warranties. Where such items are required to make the system operational, they shall be included by the supplier of the equipment at no additional cost, whether or not specifically called for.

**1.02 SECTION INCLUDES**

- A. This section includes information common to two or more technical fire suppression specification section or items that are of a general nature, not conveniently fitting into other technical sections.
  - 1. Submittals
  - 2. Construction Verification Checklists
  - 3. Functional Performance Tests
  - 4. Reference Standards
  - 5. Quality Assurance
  - 6. Design Criteria
  - 7. Guarantee
  - 8. Operation And Maintenance Instructions
  - 9. Record Documents
  - 10. Continuity Of Existing Services
  - 11. Protection Of Finished Surfaces
  - 12. Sealing And Firestopping
  - 13. Off Site Storage
  - 14. Regulatory Requirements
  - 15. Certificates And Inspections

- 16. Coordination
- 17. Demolition And Existing Requirements
- 18. Request And Certification For Payment
- 19. Sleeves And Openings
- 20. Omissions
- 21. Definitions
- 22. Project/Site Conditions
- 23. Work Sequence And Scheduling
- 24. Salvage Materials
- 25. Training
- 26. Access Panels And Doors
- 27. Identification
- 28. Demolition
- 29. Concrete Work
- 30. Cutting And Patching
- 31. Lintels
- 32. Building Access
- 33. Equipment Access
- 34. Lubrication
- 35. Housekeeping And Clean Up

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. This section applies to all Division 21 sections of fire suppression.

**1.04 SUBMITTALS**

- A. Submit shop drawings for equipment under each section per requirements listed in that section, as well as per Division 1.
- B. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission. Do not submit hard copies of web pages. Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project schedule.
- C. On request from the A/E, the successful bidder shall furnish additional drawings, illustrations, catalog data, performance characteristics, etc.
- D. Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.
- E. The submittals must be approved before fabrication is authorized.
- F. Provide electronic copies of all submittals for review.
- G. Before submitting electrically powered equipment, verify that the electrical power and control requirements for the equipment are in agreement with the motor starter schedule on the electrical drawings. Include a statement on the shop drawing transmittal to the architect/engineer that the equipment submitted and the motor starter schedule is in agreement or indicate any discrepancies.
- H. Not more than two weeks after award of contract but before any product submittals or shop drawings are submitted, contractor to submit the following fire protection system data sheet. List piping material types, ASTM number, schedule or pressure class, joint type, manufacturer and model number where appropriate. List valves, specialties and equipment with manufacturer and model number. The approved fire suppression system data sheet(s) will be made available to the Owner's Project Representative for their use on this project.
- I. Fire Suppression System Data Sheet:

Item	Pipe Service/Sizes	Manufacturer/Model No.	Remarks
Pipe			
Fittings			

Hangers & Supports  
Sprinklers  
Valves  
Specialties  
Equipment

1. Product submittals are to be bound, labeled, contain the project manual cover page and a material index list page showing item designation, manufacturer and additional items supplied with the installation. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Include wiring diagrams of electrically powered equipment.
2. Submit one (1) sample of each proposed sprinkler type to Architect/Engineer for approval.
3. Submit working plans indicating water supply location and size, piping layout and size, sprinkler locations and type, hanger locations and type, equipment locations and type, valve locations and type occupancy classes hydraulic reference points, design areas and discharge densities per NFPA 13.
4. Submit hydraulic calculations for water supply and sprinkler systems. Include summary sheet, detailed work sheets and a graphic representation of the complete hydraulic calculation plotted on semi-exponential graph paper per NFPA 13.
5. Submit working plans and hydraulic calculations for automatic sprinkler systems to the Architect/Engineer for approval prior to submittal to the local Fire Department.
6. Submit plan approval application, working plans and hydraulic calculation for automatic sprinkler systems to the owner's insurance underwriter or local AHJ for approval. Submit copy of approval letter from local Fire Department to Architect/Engineer.
7. Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:
  - a. Operating and Maintenance Manuals 2 copies
  - b. Architect/Engineer 1 copy
  - c. Local Fire Chief or Marshal 1 copy

#### **1.05 CONSTRUCTION VERIFICATION CHECKLISTS**

- A. Contractor is responsible for completing construction verification checklists.

#### **1.06 FUNCTIONAL PERFORMANCE TESTS**

- A. Contractor is responsible for completing functional performance tests.

#### **1.07 REFERENCE STANDARDS**

- A. Abbreviations of standards organizations referenced in this and other sections are as follows
  1. ANSI American National Standards Institute
  2. ASME American Society of Mechanical Engineers
  3. ASTM American Society for Testing and Materials
  4. AWWA American Water Works Association
  5. AWS American Welding Society
  6. EPA Environmental Protection Agency
  7. FM FM Global (Factory Mutual Insurance Company)
  8. FS Federal Specifications, U.S. Government Printing Office
  9. IEEE Institute of Electrical and Electronics Engineers
  10. ISA Instrument Society of America
  11. DSPPS State of Wisconsin, Department of Safety & Professional Services
  12. MSS Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
  13. NBS National Bureau of Standards
  14. NEC National Electric Code
  15. NEMA National Electrical Manufacturers Association
  16. NFPA National Fire Protection Association
  17. UL Underwriters Laboratories Inc.

## **1.08 QUALITY ASSURANCE**

- A. Substitution of Materials: Refer to Division 1 for equals and substitutions.
  - 1. Where the following conflicts with Division 1, the requirements of Division 1 shall govern.
  - 2. If the Contractor wishes to submit an alternate to the named manufacturers for any equipment, they may submit a voluntary alternative minimum 7 days prior to bid, stating the manufacturer's name, model number, written, detailed product data.
  - 3. Where materials or equipment are specified by name the proposed material or equipment must be identical to the specified material or equipment in all characteristics of quality, function and serviceability, regardless of application in the Project and, in addition, when the Architect deems that aesthetic significance is important, the equal material or equipment must be identical in all characteristics of visual appearance, design, color and texture. Any proposed equal shall be submitted to Architect/Engineer for prior approval, which Architect/Engineer may approve or disapprove in its sole discretion. Work performed or constructed with unapproved equals is at Contractor's risk and any required correction of work incorporating unapproved equals shall be at Contractor's sole cost and expense.
  - 4. In all instances, Contractor shall assume full responsibility for proof of equality of the statute to the equipment hereinafter specified. All data and information necessary for proof of equality, function and space requirements shall be prepared and accompany the submittal of the substitution to the Architect/Engineer. Approval by the Architect/Engineer of equipment other than the specified does NOT relieve Contractor of this responsibility.
- B. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.
- C. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system, including, but not limited to, coordination with other trades and any required changes by other trades and for obtaining the intended performance from the system into which these items are placed.

## **1.09 DESIGN CRITERIA**

- A. Design fire protection systems in accordance with codes, standards and regulations noted above.
- B. The fire protection systems consist of:
  - 1. Automatic dry pipe sprinkler systems in all new building areas.
  - 2. Maintenance of sprinkler coverage in remodeled areas.
- C. Water Demand Requirements:
  - 1. Hydraulically design automatic sprinkler systems for the hydraulically most remote area.
- D. Available water supply data for system design is as follows:
  - 1. Field Reading, at existing fire risers on 01/17/2017 of 75 psi.
- E. Water test data is preliminary for bidding purposes. Obtain a new flow test for design purposes. Tests shall be representative of high water use periods.

## **1.10 GUARANTEE**

- A. Refer to Division 1 for guarantees and warranties. In addition to the requirements in Division 1, this Contractor shall meet the following requirements.
- B. In entering into a contract covering this work, the contractor accepts the specifications and guarantees that the work will be carried out in accordance with the requirements of this specification or such modifications as may be made under the contract documents.
- C. Contractor further guarantees that the workmanship and material will be of the best procurable and that none but experienced workmen familiar with each particular class of work will be employed.
- D. Contractor further guarantees to replace and make good at their own expense, including travel time, all defects, which may develop within 1 year after final payment and acceptance by the Architect/Engineer, due to faulty workmanship or material, upon, receipt of written notification from the Owner.

## **1.11 OPERATION AND MAINTENANCE INSTRUCTIONS**

- A. Refer to Division 1 for operation and maintenance instructions.

- B. In addition to the general content specified under Division 1 supply the following additional documentation:
  - 1. Copies of all approved submittals along with approval letters
  - 2. Manufacturer's wiring diagrams for electrically powered equipment
  - 3. Records of tests performed to certify compliance with system requirements
  - 4. Certificates of inspection by regulatory agencies
  - 5. Parts lists for equipment and specialties
  - 6. Manufacturer's installation, operation and maintenance recommendations for equipment and specialties
  - 7. Valve schedules
  - 8. Lubrication instructions, including list/frequency of lubrication
  - 9. Warranties
  - 10. Copy of NFPA 25 – Standard for Inspection, Testing & Maintenance of Water-Based Fire Protection, latest edition
  - 11. Additional information as indicated in the technical specification sections

### **1.12 RECORD DOCUMENTS**

- A. Refer to Division 1 for record documents.
- B. In addition to the general content specified under Division 1, follow the following procedures.
  - 1. During the progress of the work, Contractor shall maintain a current (daily) record set of the drawings and specifications, indicating thereon all work installed at variance with such Contract Documents including, without limitation, work covered by Addenda, Field Work Orders, Change Orders and Engineers additional instructions, interpretations and clarification. All changes or deviations from the original layout of the work and all critical dimensions of buried or concealed work shall be recorded. It shall be Contractor's responsibility to assure that said record sets are complete, accurate and up-to-date, Engineer shall have the right to inspect and review such record sets.
  - 2. At the completion of the work, the Contractor shall indicate on record drawing sets all changes and such additional details as necessary or appropriate to provide a complete reference document for use by Engineer. If variations and details cannot be shown clearly thereon, the Contractor shall prepare supplemental drawings adequate to impart the information. The foregoing drawings collectively shall constitute the "Record" drawings for the work.
  - 3. All indication on "Record" drawings shall be executed in a legible manner at Contractor's cost, using methods and legend presentations compatible with the overall scheme of the record drawings with respect to scale, drawing sheet sizes and sequential indexing. All changes shall be marked clearly in red and clouded.
  - 4. Engineer may review Contractor's "Record" drawings and notify Contractor of observed discrepancies or deviations. Contractor shall promptly correct discrepancies, deviations or illegible markups at Contractor's expense and resubmit revised drawings for Engineer review.
  - 5. Contractor shall provide final electronic record drawings to the Owner through the Engineer.
- C. In addition to the data indicated in Division 1, maintain fire protection layout record drawings and hydraulic calculations on originals prepared by the installing contractor/subcontractor. Include copies of these record drawings and calculations with the Operating and Maintenance manuals.

### **1.13 CONTINUITY OF EXISTING SERVICES**

- A. Do not interrupt or change existing services without prior written approval from the Owner's Project Representative. When interruption is required, coordinate scheduling of down-time with the Owner to minimize disruption to his activities. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.
- B. Each Contractor shall thoroughly familiarize himself with existing systems which will affect and be affected by relocation of existing equipment and installation of new lines and equipment. They shall plan installation of their work so that interruptions of services to any building or portion thereof will be a minimum and such interruptions shall occur only when system is not required, if possible. If not possible, each Contractor shall insure the operation of services by whatever means possible, such as, installing bypasses, capping of services or providing temporary service. Each interruption shall be for as short a duration as possible.

- C. No extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours.
- D. This Contractor shall restore any circuit interruption as a result of this work to proper operation as soon as possible. Note that institutional operations are on a seven day week schedule.

**1.14 PROTECTION OF FINISHED SURFACES**

- A. Refer to Division 1 for protection of finished surfaces.

**1.15 SEALING AND FIRESTOPPING**

- A. Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.
- B. Contractor shall request current life safety drawings from the Architect/Owner.

**1.16 OFF SITE STORAGE**

- A. If payment will be requested for approved offsite stored material, then the Contractor shall complete an "Offsite Storage Agreement" which is available from the Owner. Prior approval by Owner's personnel for offsite storage will be needed. No material will be accepted for offsite storage unless submittals for the material have been approved.

**1.17 REGULATORY REQUIREMENTS**

- A. Comply with requirements of Wisconsin Administrative Code, Department of Safety & Professional Services, Department of Health Services, NFPA Standards and local Authority Having Jurisdiction (AHJ) regarding design, materials and installation.

**1.18 CERTIFICATES AND INSPECTIONS**

- A. Refer to Division 1 for permits, regulations, utilities and taxes.
- B. Obtain and pay for all required State or local installation inspections except those provided by the Architect/Engineer in accordance with State Code. Deliver originals of these certificates to the Owner. Include copies of the certificates in the Operating and Maintenance Instructions.
- C. Coordinate and provide inspections as required by the authority having jurisdiction over the site.

**1.19 COORDINATION**

- A. Refer to Division 1 for coordination. In addition to the requirements specified under Division 1, the following requirements apply.
- B. It shall be the responsibility of each Contractor to coordinate and consult with each other to determine space requirements and to determine that adequate space for servicing is provided for all equipment whether furnished by the Contractor or others. The General Contractor shall have final decision on all space priority conflicts among Contractors. All space priority conflicts shall be brought to the attention of the Architect/Engineer and Owner's Representative.
- C. Each Contractor shall thoroughly familiarize themselves with existing systems which will affect and be affected by relocation of existing equipment and installation of new lines and equipment. They shall plan installation of their work so that interruptions of services to any building or portion thereof will be a minimum, and such interruptions shall occur only when system is not required, if possible. If not possible, each Contractor shall insure the operation of services by whatever means possible, such as, installing bypasses, capping of services, or providing temporary service. Each interruption shall be for as short a duration as possible.
- D. Cooperation among all Contractors shall be required. Any Work that is installed without cooperating or coordinating with other Contractors and is in conflict shall be removed and reinstalled at that particular Contractor's expense. No cost additions to the project will be considered due to a Contractor's lack of participation in the cooperation and coordination process. The following list of items of Work shall be the priority of order for all Contractors:
  - 1. Structure
  - 2. Recessed light fixtures

3. Gravity-flow systems for sanitary, storm, steam and steam condensate piping
  4. Ductwork and appurtenances
  5. Electrical and low voltage cable tray
  6. Plumbing vent piping
  7. Fire protection (sprinkler system)
  8. HVAC piping
  9. Gas piping, process piping and domestic water
  10. Electrical conduit and low voltage conduit
  11. Control air lines or conduit
- E. The above list, in descending order, is the precedence assigned the Work items for space priority. Gravity-flow systems have first priority.
- F. Exception: Plumbing lines below or behind plumbing fixtures shall have precedence over all other work. Electrical conduit above or below switchgear, panelboards and control panels shall have precedence over all other work. Do not install any fluid conveying piping over electrical equipment.
- G. In the case of interconnection of the work of two or more contractors, verify at the site or on shop drawings all dimensions relating to such work. All errors due to the failure to so verify any such dimensions shall be promptly rectified.
- H. Any installed work that is not coordinated and interferes with another contractor's work shall be removed or relocated at the installing contractor's expense.

#### **1.20 DEMOLITION AND EXISTING REQUIREMENTS**

- A. Existing active services: water, gas, steam, ventilation, compressed or control air, sanitary waste, sanitary vent, storm electric, and any other building systems when encountered shall be protected against damage. Where existing services are to be abandoned, the services shall be removed back to the point of origin and removed from the site unless otherwise directed by the Owner's Representative.
- B. Submit a "Sequence of Work Schedule" in respect to all temporary and permanent utility and service cutovers after final determination. This schedule shall be submitted for approval to the Owner and Architect/Engineer. The submittal shall designate priority order, service or utility affected, date of cutover, and time of day to start and finish.
- C. Bidders should inspect the site to become familiar with conditions of the site which will affect the Work. Bidders should verify points of connection with utilities, routing of outside piping to include required clearances from any existing structures, or other obstacles.
- D. Extra payment will not be allowed for changes in the Work required because of the successful bidder's failure to make this inspection.

#### **1.21 REQUEST AND CERTIFICATION FOR PAYMENT**

- A. Within 10 days after Notice to Proceed, the successful bidder will submit to the Owner's Project Representative in a form prescribed by Division 1, a cost breakdown of the proposed values for work performed which, if approved by the owner, will become the basis for construction progress and monthly payments. The cost breakdown items shall reflect actual work progress stages as closely as feasible.
- B. In addition, if payment is requested for approved off-site stored material, then that material shall be listed as a line item in the request and certification for payment cost breakdown.

#### **1.22 SLEEVES AND OPENINGS**

- A. Openings required in new or existing construction that may be necessary for the installation of new work shall be provided by the respective contractor and all patching and repairing shall be done by workmen competent in the trade required, at the expense of the respective contractor. The respective contractor shall be responsible for arranging the work so that minimum cutting will be required. All rubbish and excess materials involved in such cutting shall be promptly removed from the site and disposed of by the contractor. Cutting through the floor or roof systems or load bearing walls shall be done only with the prior written approval of the Architect/Engineer so as to avoid damaging the structural system.

### **1.23 OMISSIONS**

- A. No later than ten (10) days before bid opening, the Contractor shall call the attention of the A/E to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

### **1.24 DEFINITIONS**

- A. Wherever the words “the Contractor”, “this Contractor” or “Fire Protection Contractor” appear in this division, they refer to the Contractor for Fire Protection work.
- B. The term “provide” includes such labor, methods, materials, equipment and transportation or other facilities required to complete the Contract and the performance of all duties thereby upon the Contractor.

### **1.25 PROJECT/SITE CONDITIONS**

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of A/E before proceeding.
- C. Tools, materials and equipment shall be confined to areas designated by the Owner’s project representative.

### **1.26 WORK SEQUENCE AND SCHEDULING**

- A. Install work in phases to accommodate Owner's occupancy requirements. During the construction period coordinate schedule and operations with Owner's Construction Representatives.

### **1.27 SALVAGE MATERIALS**

- A. No materials removed from this project shall be reused (except as specifically noted below). All materials removed shall become the property of and shall be disposed of by the Contractor.

### **1.28 TRAINING**

- A. The contractor shall have the following responsibilities:
  - 1. Provide a training plan thirty days before the planned training covering the following elements:
    - a. Equipment
    - b. Intended audience
    - c. Location of training
    - d. Objectives
    - e. Subjects covered (description, duration of discussion, special methods, etc.)
    - f. Duration of training on each subject
    - g. Instructor for each subject
    - h. Methods (classroom lecture, manufacturer’s quality video, site walk-through, actual operational demonstrations, written handouts, etc.).
  - 2. Provide designated owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment that makes up the system.
  - 3. Training shall normally start with classroom sessions followed by hands-on demonstration/training on each piece of equipment.
  - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system shall be repaired or adjusted as necessary and the demonstration repeated at another scheduled time, if necessary.
  - 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
  - 6. The controls contractor shall attend sessions other than the controls training, as specified, to discuss the interaction of the controls system as it relates to the equipment being discussed.
  - 7. The training sessions shall follow the outline in the table of contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.



8. Training shall include:
    - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
    - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include startup, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
    - c. Discussion of relevant health and safety issues and concerns.
    - d. Discussion of warranties and guarantees.
    - e. Common troubleshooting problems and solutions.
    - f. Explanatory information included in the O&M manuals.
    - g. Discussion of any peculiarities of equipment installation or operation.
    - h. Classroom sessions shall include the use of overhead projections, slides, video/audiotaped material as might be appropriate.
    - i. Hands-on training shall include startup, operation in all modes possible, including manual, shut-down, alarms, power failure and any emergency procedures, and preventative maintenance for all pieces of equipment.
  9. The contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls not controlled by the central control system.
- B. Provide a minimum of 4 hours of instruction.
  - C. Provide additional training as specified in other specification sections for specific equipment.

## **PART 2 – PRODUCTS**

### **2.01 ACCESS PANELS AND DOORS**

- A. Lay-in Ceilings: Removable lay-in ceiling tiles in 2 x 2 foot or 2 x 4 foot configuration provided under Division 09 are sufficient; no additional access provisions are required unless specifically indicated.
- B. Concealed Spline Ceilings: Removable sections of ceiling tile held in position with metal slats or tabs compatible with the ceiling system used will be provided under Division 09.
- C. Metal Pan Ceilings: Removable sections of ceiling tile held in position by a pressure fit will be provided under Division 09.
- D. Plaster Walls and Ceilings: 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" by 12".

### **2.02 IDENTIFICATION**

- A. Adhesive Labels: Pressure-sensitive, adhesive backed, vinyl pipe markers with applicable labeling, ¾" min. size for lettering and surrounding tape on both ends. With flow arrows on piping. Conforming to ANSI, ANSI and NFPA standards.
- B. Snap-Around Markers: One-piece, pre-formed, vinyl construction, snap-around or strap-around pipe markers with applicable labeling, ¾" min. size for lettering. Provide nylon ties on each end of pipe marker.
- C. Signs: Permanently marked weatherproof metal or rigid plastic sign conforming to NFPA 13, secured with corrosion-resistant wire, chain, or other means.
  1. Engraved Name Plates: White letters on a black background, 1/16" thick plastic laminate, beveled edges, screw mounting.
- D. Valve Tags: Round brass tags with ½" numbers, ¼" system identification abbreviation, 1¼" minimum diameter, with brass jack chains with brass "S" hooks or one piece nylon ties around the valve stem.

## **2.03 SLEEVES AND OPENINGS**

### **A. General:**

1. Pipe sleeves shall be constructed of standard weight ASTM A53 or ASME B36.10 steel with an anchor plate constructed of A36/A36M steel welded to the pipe. The sleeve shall be sized a minimum of 1" larger than piping insulation diameter. The entire assembly shall be hot-dip galvanized after fabrication.
2. Duct sleeves and piping sleeves passing through interior walls shall be constructed of 24 gauge galvanized steel minimum thickness.

### **B. Sleeves Through Below Grade Walls:**

1. Provide steel pipe sleeve, ASTM A53, pressure sealing with membrane clamp ring, gasket, water stop ring, external rings, and nitrile rubber link seals. The assembly shall be hot-dip galvanized after fabrication.
  - a. Seals: Modular mechanical type seals, consisting of interlocking nitrile rubber links shaped to continuously fill the annular space between the pipe and the sleeve and electrically isolate the carrier pipe from the steel sleeve.
  - b. Sealing Element: Polychloroprene rubber material compounded to resist aging, ozone, sunlight, hydrocarbon gases, water, and chemical action.
  - c. Hardware: Type 300 series stainless steel fasteners. Threads rolled to produce smooth uniform threads and unbroken flow lines.
  - d. Compression Plates: Fiberglass-reinforced polyester plastic, injection molded for high physical properties, dielectric strength and non-cold flow creep characteristics, having high resistance to acidic and alkaline soils.
2. For sleeves located 15 feet or more below grade provide cast iron sleeve ASTM A74 with compression seals.

## **2.04 SEALING AND FIRESTOPPING**

### **A. Fire and/or Smoke Rated Penetrations**

1. Manufacturers: 3M, Hilti, STI/SpecSeal, Tremco.
2. All firestopping systems shall be provided by the same manufacturer.
3. Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by the Authority Having Jurisdiction (AHJ).
4. Submittals: Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon
5. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
6. Use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.
7. All sealants shall meet the intent of LEED® VOC requirements, <250 g/L VOC contents (less H<sub>2</sub>O and exempt solvents).

### **B. Non-Rated Penetrations:**

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

## **PART 3 – EXECUTION**

### **3.01 DEMOLITION**

- A. Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to be performed adjacent to existing work that remains in an occupied area, construct

temporary dust partition to minimize the amount of contamination of the occupied space. Where pipe is removed and not reconnected with new work, cap ends of existing services as if they were new work. Coordinate work with the Owner to minimize disruption to the existing building occupants.

- B. All pipe, sprinklers, equipment, wiring, associated conduit and similar items demolished, abandoned, or deactivated are to be removed from the site by the Contractor except as specifically noted otherwise. All designated equipment is to be turned over to the Owner at a place and time designated. Maintain the condition of material and/or equipment that is indicated to be reused equal to that existing before work began.
- C. All contractors requiring the personnel/ material hoist and or temporary construction elevator (i.e. new elevators, temporarily protected) at times other than outlined in the temporary facilities specifications will make arrangements directly with the general contractor. The general contractor is responsible for all coordination and scheduling of the use of any hoisting equipment so the flow of the project is smoothly maintained and all workers have access to the work areas to perform their work and deliver material to the areas needed according to the project schedule.
- D. If any contractor's work requires the removal and replacement of any finished materials including but not limited to such materials as ceiling tiles, wall finishes, cabinets, doors, flooring, windows, etc. after those items are installed, each contractor will be responsible, at no additional cost to the owner, to replace any damaged, soiled or lost materials with new materials to match the existing materials and those materials damaged.

### **3.02 CONCRETE WORK**

- A. Cast-in-place concrete within the building will be performed by the Division 3 Contractor. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for support or installation of piping, specialties and equipment. Coordinate locations of equipment, pipe penetrations in wet areas, etc. with the Division 3 Contractor.

### **3.03 CUTTING AND PATCHING**

- A. Refer to Division 1 for cutting and patching. In addition to the requirements in Division 1:
- B. Each Contractor shall coordinate the placing of openings in the new structure as required for the installation of each Contractor's work.
- C. Each Contractor shall furnish to the General Contractor the accurate locations and sizes for required openings in the new work, but this shall not relieve each Contractor of the responsibility of checking to assure that properly sized openings are provided. When additional patching is required due to the Contractor's failure to inspect this work, then the Contractor shall make arrangements for the patching required to properly close the openings to include patch painting, and the Contractor shall pay any additional cost incurred in this respect.
- D. If cutting and patching of the new structure is made necessary due to the Contractor's failure to install piping, ducts, sleeves, or equipment on schedule, or due to the Contractor's failure to furnish on schedule the information required for the leaving of openings, then it shall be the Contractor's responsibility to make arrangements and obtain approval from the General Contractor and Architect/Engineer for this cutting and patching, and the Contractor shall pay any additional cost incurred in this respect. The Contractor shall also reimburse the Owner for any additional costs incurred to the Architect/Engineer for additional services caused by the Contractor in this respect.
- E. The Contractor shall provide cutting and patching and patch painting in the existing structure as required for the installation of their work and shall furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Architect/Engineer. Extent of cutting shall be minimized; use core drills, power saws, or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

### **3.04 LINTELS**

- A. This contractor shall design, fabricate, and install all lintels required in masonry walls for duct and pipe penetrations.

### **3.05 BUILDING ACCESS**

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

### **3.06 EQUIPMENT ACCESS**

- A. Install all piping, conduit and accessories to permit access to equipment for maintenance and service. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Access doors in general construction are to be furnished by the Fire Protection Contractor and installed by the General Contractor.
- B. Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not require access panels.

### **3.07 COORDINATION**

- A. Coordinate all work with other contractors prior to installation. Any work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
- B. Verify that all devices are compatible for the type of construction and surfaces on which they will be used.

### **3.08 IDENTIFICATION**

- A. Identify equipment in mechanical equipment rooms with engraved name plates.
- B. Identify interior piping mains 2½" and larger not less than once every 25 feet, not less than once in each room, adjacent to each access door or panel, and on both sides of the partition where exposed piping passes through walls or floors. Place flow directional arrows at each pipe identification location.
- C. Provide hydraulic design information sign of permanently marked weatherproof metal or engraved nameplate material. Secure to system risers. Information to include location of the design areas, discharge densities, required flow and residual pressure at the base of riser, hose stream demand and sprinkler demand.

### **3.09 SLEEVES AND OPENINGS**

- A. General:
  - 1. Sleeves are not required for piping and ducts passing through interior non-rated drywall, plaster, or wood partitions and interior poured concrete walls that have been saw cut or core drilled.
  - 2. Pack annular space between sleeves and pipe or ducts with fiberglass insulation and seal.
  - 3. Piping sleeves that pass through fire rated floors, walls, or ceilings shall be provided with a UL listed fire stop material meeting UL 1479 to seal the opening between the pipe and the pipe sleeve to maintain the fire rating.
  - 4. Provide escutcheon plates on piping to cover sleeve and insulation in finished areas.
  - 5. Refer to Division 1 for additional information on sleeves and openings.
- B. Sleeves Through Floors/Ceilings:
  - 1. Sleeves shall be installed to extend 1 inch above finished floor with a watertight sealant between floor and sleeve in all mechanical rooms and wet rooms listed below.
  - 2. If a sleeve is not provided, provide 1-1/2 inch angle ring with urethane caulk between the angle and the floor and seal at the corners to form a watertight seal.
  - 3. Wet Locations:
    - a. Mechanical rooms
    - b. Food service/kitchen areas (behind/under equipment, cabinets, tables, etc.)

### **3.10 SEALING AND FIRESTOPPING**

- A. The Contractor shall refer to building life safety drawings for all smoke and fire rates in addition to the mechanical drawings. Any discrepancies shall be brought to the attention of the Architect/Engineer before final addendum.
- B. Fire And/Or Smoke Rated Penetrations:

1. Install approved product in accordance with the manufacturer's instructions where a pipe penetrates a fire/smoke rated surface.
  2. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support substantial weight.
- C. Non-Rated Partitions:
1. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe is completely blocked.

### **3.11 HOUSEKEEPING AND CLEAN UP**

- A. The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

END OF SECTION

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

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Unless noted otherwise, the Fire Protection Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes specifications for supports of all fire suppression equipment and materials.
  - 1. Pipe Hangers And Supports
  - 2. Pipe Hanger Rods
  - 3. Beam Clamps
  - 4. Concrete Inserts
  - 5. Equipment Stands
  - 6. Corrosive Atmosphere Coatings

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Section 21 05 00 – Common Work Results for Fire Suppression
- C. Section 21 10 00 – Water-Based Fire Suppression Systems
- D. Division 3 – Concrete

**1.04 SUBMITTALS**

- A. Refer Section 21 05 00 – Common Work Results for Fire Suppression, Submittals. In addition to the general content specified under Section 21 05 00 – Common Work Results for Fire Suppression, supply the following submittals:
  - 1. Pipe Hangers And Supports
  - 2. Pipe Hanger Rods
  - 3. Beam Clamps
  - 4. Concrete Inserts
  - 5. Equipment Stands
  - 6. Corrosive Atmosphere Coatings
- B. Schedule of all hanger and support devices indicating attachment methods and type of device for each pipe size and type of service. Provide details on the working drawings submitted for approval with all pertinent information listed.

**1.05 REFERENCE STANDARDS**

- A. MSS SP-58 Pipe Hangers and Supports – Materials, Design, and Manufacture
- B. MSS SP-69 Pipe Hangers and Supports – Selection and Application
- C. NFPA 13 Installation of Sprinkler Systems (Latest edition)
- D. NFPA 14 Installation of Standpipe and Hose Systems (Latest edition)
- E. NFPA 20 Installation of Stationary Pumps for Fire Protection (Latest edition)
- F. UL Underwriters' Laboratories Listed.
- G. FM FM Global

**1.06 QUALITY ASSURANCE**

- A. Substitution of Materials Refer to Division 1 for equals and substitutions.

**1.07 DESIGN CRITERIA**

- A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless noted otherwise.
- B. Materials and application of pipe hangers and supports shall be in accordance with NFPA and be UL/FM listed and approved.

## 1.08 DESCRIPTION

- A. Provide all supporting devices as required for the installation of equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for building piping.
- B. Do not hang any fire suppression item directly from a metal deck or run piping so its rests on the bottom chord of any truss or joist.
- C. Fasteners depending on soft lead for holding power or requiring explosive powder actuation will not be accepted.
- D. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.

## PART 2 - PRODUCTS

### 2.01 PIPE HANGERS AND SUPPORTS

- A. Manufacturers: Cooper/B-Line, Anvil, Pate, Piping Technology, Roof Products & Systems
- B. Hangers for Pipe Sizes ½" through 4":
  - 1. Carbon steel, adjustable swivel ring with 3/8" min. UL/FM approved hanger rods.
  - 2. Carbon steel, adjustable clevis, standard, with UL/FM approved size hanger rods.
- C. Hangers for Pipe Sizes 4" Through 8":
  - 1. Carbon steel adjustable swivel ring with ½" min. UL/FM approved hanger rods.
  - 2. Carbon steel, adjustable clevis, standard with UL/FM approved size hanger rods.
- D. Hangers for Pipe Sizes 10" and Larger:
  - 1. Carbon steel, adjustable clevis, standard with UL/FM approved size hanger rods.
- E. Wall Support:
  - 1. Carbon steel welded bracket with hanger.
  - 2. Steel channels with pipe clamps.
- F. Vertical Support:
  - 1. Carbon steel riser clamp.
- G. Floor Support:
  - 1. Carbon steel pipe saddle, stand and bolted floor flange.

### 2.02 PIPE HANGER RODS

- A. Steel Hanger Rods:
  - 1. Threaded both at ends, threaded one end, or continuously threaded, complete with adjusting and lock nuts.
- B. Size rods for individual hangers and trapeze support as indicated in the following schedule.

<u>Pipe Size</u>	<u>Minimum Diameter of Rod</u>
4" and Smaller	3/8" or 10 mm
5", 6" and 8"	½" or 13 mm
10" and 12"	5/8" or 16 mm

### 2.03 BEAM CLAMPS

- A. MSS SP-69 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a retaining ring and threaded rod of 3/8, 1/2, and 5/8 inch diameter. Furnish with a hardened steel cup point set screw.
- B. MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1 ½" diameter.

### 2.04 CONCRETE INSERTS

- A. Poured in Place:
  - 1. MSS SP-69 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity.



2. MSS SP-69 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter.
- B. Drilled Fasteners:
1. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor.

**2.05 EQUIPMENT STANDS**

- A. Use structural steel members welded to and supported by pipe supports. Clean, prime and coat with three coat rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere coatings.

**2.06 CORROSIVE ATMOSPHERE COATINGS**

- A. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123, 1.5 ounces/square foot of surface each side. Mechanical galvanize threaded products, ASTM B695 Class 50, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.
- B. Corrosive atmospheres include the following locations:
1. Chemical storage and hazardous waste storage rooms
  2. Food service/kitchen areas
  3. Walk-in coolers/freezers

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

- A. Size, apply and install supports in compliance with manufacturer's recommendations.
- B. Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- C. Select and install hangers and supports in conformance with NFPA standards.
- D. Perform welding in accordance with standards of the American Welding Society.

**3.02 HANGER AND SUPPORT SPACING**

- A. Except where permitted by NFPA there shall be not less than one hanger for each section of pipe.
- B. Use hangers with minimum 1½" vertical adjustment.
- C. Support riser piping independently of connected horizontal piping.
- D. Adjust hangers to obtain the slope specified in the piping section of these specifications.
- E. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Max. Horiz. Spacing	Max. Vert. Spacing
Steel	1" through 1 ¼"	12'-0"	15'-0"
Steel	1 ½" through 8"	15'-0"	15'-0"
Steel	8" through 12"	15'-0"	20'-0"

- F. Unsupported length from the last hanger and an end sprinkler shall be as follows:
- |                          |                      |
|--------------------------|----------------------|
| 1. 1" piping             | Not greater than 36" |
| 2. 1 ¼" piping           | Not greater than 48" |
| 3. 1 ½" piping or larger | Not greater than 60" |

**3.03 RISER CLAMPS**

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

END OF SECTION

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**SECTION 21 10 00**  
**WATER-BASED FIRE SUPPRESSION SYSTEMS**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Unless noted otherwise, the Fire Protection Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section contains specifications for fire suppression pipe, pipe fittings, sprinklers, valves, switches and related items for automatic sprinkler and standpipe systems in this project.
  - 1. Fire Protection Piping
  - 2. Unions and Flanges
  - 3. Mechanical Grooved Pipe Connections
  - 4. Sprinklers
  - 5. Flexible Sprinkler Connections
  - 6. Switches
  - 7. Local Alarm Horn/Strobe
  - 8. Pressure Gauges
  - 9. Valves
  - 10. Dry Valves
  - 11. Specialties
  - 12. Air Compressor

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 01 91 13 – Commissioning Requirements
- C. Section 21 05 00 – Common Work Results for Fire Suppression
- D. Section 21 05 29 – Hangers and Supports for Fire Suppression Piping and Equipment

**1.04 SUBMITTALS**

- A. Refer Section 21 05 00 – Common Work Results For Fire Suppression, Submittals. In addition to the general content specified under Section 21 05 00 – Common Work Results For Fire Suppression, supply the following submittals:
  - 1. Fire Protection Piping
  - 2. Unions and Flanges
  - 3. Mechanical Grooved Pipe Connections
  - 4. Sprinklers
  - 5. Flexible Sprinkler Connections
  - 6. Switches
  - 7. Local Alarm Horn/Strobe
  - 8. Pressure Gauges
  - 9. Valves
  - 10. Dry Valves
  - 11. Specialties
  - 12. Air Compressor
- B. Schedule from the contractor indicating the ANSI/ASTM specification number of the pipe being proposed along with its type and grade, if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.

**1.05 REFERENCE STANDARDS**

- A. ANSI A21.4
- B. ANSI A21.11
- C. ANSI A21.51

- D. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings
- E. ANSI B16.3 Malleable Iron Threaded Fittings
- F. ANSI B16.4 Cast Iron Threaded Fittings
- G. ANSI B16.5 Pipe Flanges and Flanged Fittings
- H. ANSI B16.9 Factory Made Wrought Steel Buttweld Fittings
- I. ANSI B16.11 Forged Steel Fittings, Socket Welded and Threaded
- J. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
- K. ASTM A105 Forgings, Carbon Steel, for Piping Components
- L. ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
- M. ASTM A135 Electric Resistance Welded Steel Pipe
- N. ASTM A181 Forgings, Carbon Steel for General Purpose Piping
- O. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- P. ASTM A536 Ductile Iron Castings
- Q. ASTM A795 Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
- R. AWS D10.9 Qualification of Welding Procedures and Welders for Piping and Tubing, Level AR3
- S. NFPA 13 Installation of Sprinkler Systems. ( Latest edition )
- T. NFPA 14 Installation of Standpipe and Hose Systems. ( Latest edition )
- U. UL Underwriters' Laboratories
- V. FM FM Global

**1.06 QUALITY ASSURANCE**

- A. Substitution of Materials: Refer to Division 1 for equals and substitutions.
- B. Order all pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

**1.07 DESIGN CRITERIA**

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
- B. Construct all piping systems for the highest pressures and temperatures in the respective system but not less than 175 psig.
- C. Where ASTM A53 or A795 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where ASTM A135 grade A pipe is specified, grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

**1.08 DELIVERY, STORAGE AND HANDLING**

- A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Storage and protection methods must allow inspection to verify products.

**1.09 WELDER QUALIFICATIONS**

- A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is performed,

Contractor to submit their Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.

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

## **PART 2 – PRODUCTS**

### **2.01 FIRE PROTECTION PIPING**

- A. Steel Pipe:
1. Black steel pipe welded and seamless, Type F, Grade A, ASTM A53; black welded and seamless steel pipe for fire protection use, Type F, ASTM A795; electric resistance welded steel pipe, Grade A, ASTM A135.
  2. Unscheduled specialty steel pipe is not acceptable.
  3. Pipe Wall Thickness: Schedule 40 for welded, rolled groove, cut groove and threaded. Schedule 30 for welded, rolled groove, 8" and larger cut groove and 8" and larger threaded piping. Schedule 10 up to and including 6" for rolled groove and welded.
  4. Fittings: 2" and Smaller - Cast iron threaded fittings, Class 125 or 250, ASTM A126/ANSI B16.4. Malleable iron threaded fittings, Class 150 or 300, ASTM A197/ANSI B16.3. Standard weight seamless carbon steel weld fittings, ASTM A234 grade, ANSI B16.9. Mechanical grooved fittings with EPDM gaskets, ASTM A536 ductile iron, ASTM A47 malleable iron or ASTM A53 fabricated steel.
  5. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
  6. Finish: Hot dipped zinc coated (galvanized) finish on piping and fittings shall be used in dry sprinkler or combined pipe systems, pre-action systems, piping exposed to weather and piping exposed to corrosive environments where indicated. Thread or cut groove hot dipped zinc coated pipe ends for fitting connection.

### **2.02 UNIONS AND FLANGES**

- A. 2" and Smaller Steel: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.
- B. 2 ½" and Larger Steel: ASTM A181 or A105, Class 150, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. ANSI B16.1 or ANSI B16.5, Class 150 cast iron threaded flanges. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.

### **2.03 MECHANICAL GROOVED PIPE CONNECTIONS**

- A. Manufacturers: Victaulic, Anvil, Star Fittings
- B. All mechanical grooved pipe material including gaskets, couplings, fittings and flange adapters to be from the same manufacturer. Mechanical grooved components and assemblies to be rated for minimum 175 psi working pressure unless noted otherwise.
- C. Couplings and fittings to be malleable iron, ASTM A47 or ductile iron A536 with painted finish. Fittings used on galvanized steel pipe to have galvanized finish, ASTM A153.
- D. Gaskets to be EPDM, ASTM D2000. Gaskets for dry systems to be flush seal design. Heat treated carbon steel oval neck track bolts and nuts, ASTM A-183, with zinc electroplated finish.
- E. Flange adapters to be ductile iron, ASTM A536; except at lug type butterfly valves where standard threaded flanges shall be used.
- #### **SPRINKLERS**
- A. Manufacturers: Grinnell, Reliable, Tyco, Viking, Globe
- B. Fusible link or glass bulb type, cast brass or bronze construction. Provide sprinklers with minimum nominal ½" discharge orifice.
1. Quick Response Pendant: White finish and escutcheon
  2. Quick Response Concealed Pendant: White cover plate
  3. Quick Response Sidewall: White finish and escutcheon

4. Quick Response Dry Pendant: Adjustable, recessed, with chrome escutcheon

**2.05 FLEXIBLE SPRINKLER CONNECTORS**

- A. Manufacturers: Aqua Flex, Flex Head, Sprinkflex, Victaulic, Viking
- B. UL/FM Type 304 stainless steel flexible sprinkler connection, 175 psi rated, braided flexible stainless steel tubing with 1" diameter internal corrugated hose, stainless steel hose nipples, and galvanized steel attachment brackets for use in either suspended or hard ceilings.

**2.06 SWITCHES**

- A. Manufacturers: Potter Electric Signal, System Sensor, Notifier
- B. Flow Switches: Vane type waterflow switch with metal enclosure, adjustable pneumatic retard and electrical characteristics compatible with alarm system.
- C. Supervisory Switches for O. S. & Y. gate valve installations: UL/FM listed/approved, to monitor position of valve, tamper resistant cover screws, single or double SPDT switch contacts, corrosion resistant, for indoor or outdoor use, NEMA 4 & 6P enclosures.
- D. Pressure Switches: Pressure actuated switch with field adjustable settings, metal enclosure and electrical characteristics compatible with alarm system.

**2.07 LOCAL ALARM HORN/STROBE**

- A. Manufacturers: Potter Electric Signal, Gentex, System Sensor, Simplex, Siemens, Wheelock
- B. UL listed multi-tone electric horn and strobe for outdoor use, with red finished housing, white lettering, weatherproof backbox, 12/24 VDC, and electrical characteristics compatible with building alarm system. Potter SASH-24.

**2.08 PRESSURE GAUGES**

- A. Manufacturer: Ametek/U. S. Gauge Division, Ashcroft, Marsh, Taylor, H. O. Trerice, Weiss, Weksler.
- B. Cast aluminum, stainless steel or brass case of not less than 3.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor bronze bourdon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale. Include bronze 3-way globe valve with plugged outlet for Fire Inspector's test gauge.

**2.09 VALVES**

- A. Manufacturers: Kennedy, Milwaukee, Nibco, Stockham, Viking, Watts
- B. Gate Valves
  1. 2" and smaller: Outside screw and yoke gate valves, 175 psig, bronze body, bronze mounted, screwed bonnet, rising stem, solid wedge.
  2. 2½" and larger: Outside screw and yoke gate valves, 175 psig, cast iron body, bronze mounted, bolted bonnet, rising stem, solid wedge.
- C. Butterfly Valves
  1. 2" and smaller: Bronze body butterfly valve, 175 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, Buna or Viton seat, stainless steel disc and stem.
  2. 2½" and larger: Cast or ductile iron body butterfly valve, lug style or grooved, 175 psig, geared operator, visible position indicator, normally open supervisory/tamper switch with double wire leads, EPDM resilient seat, EPDM seals, nickel plated ductile iron disc. Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached.
- D. Check Valves
  1. 2" and smaller: Bronze body, threaded end, Y-pattern, regrindable bronze seat, renewable bronze disc, 175 psig, suitable for installation in a horizontal or vertical line with flow upward.
  2. 2½" and larger: Cast or ductile iron body, flanged or grooved ends, bronze trim, bolted cap, renewable bronze seat and disc, 175 psig, suitable for installation in a horizontal or vertical line with flow upward.
  3. Provide ½" automatic drip drain on inlet of fire department connection check valve.

- E. Drain valves
  - 1. 3/4" min. two or three piece bronze body ball valve with threaded ends, chrome plated bronze ball, glass filled Teflon seat, Teflon packing and threaded packing nut, blowout-proof stem, 400 psig WOG, and capped hose thread outlet.

## **2.10 DRY VALVES**

- A. Manufacturers: Reliable, Tyco, Victaulic, Viking, Globe
- B. Cast or ductile iron body, flanged or grooved ends, 175 psig, bronze grooved seat with o-ring seal, single hitch pin and latch design. Provide trim for air supply, drain, priming level, alarm connections, pressure gauges, priming chamber attachment, ball drip valves, drip cup assembly piped to floor or hub drain, and fill line attachment with strainer.

## **2.11 SPECIALTIES**

- A. Manufacturers: Reliable, Tyco, Victaulic, Viking, Globe
- B. Air Pressure Maintenance Device
  - 1. Automatic control capable of maintaining system air pressure, rated for 175 psig, adjustable air pressure range of 15 to 60 psig, complete with isolation valves, bypass fill valve, pressure regulator or pressure switch and strainer.
- C. Emergency Pull Box
  - 1. 1/2" ball valve in metal enclosure with 1/2" pipe nipple, "Manual Emergency Station" label and breakaway door

## **2.12 AIR COMPRESSOR**

- A. Manufacturer: Gast, Quincy, Viking
- B. Simplex electric motor belt driven oil lubricated compressor mounted on ASME rated galvanized receiver tank, pressure operated electric switch, motor, magnetic motor starter with three phase overload protection, fused disconnect switch, safety relief valve, check valve, shutoff valve, pressure gauge, automatic tank drain, intake muffler-filter, belt guard and adjustable operating pressure control.

# **PART 3 - EXECUTION**

## **3.01 GENERAL**

- A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.
- B. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of fire protection piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, ceiling grid layout, light fixtures and grilles before installing piping.
- C. Where piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- D. Provide 3/32" min. thickness steel nailing plates behind or on either side of piping where the possibility of penetration from nails or drywall screws exists.
- E. Maintain piping in clean condition internally during construction.
- F. Provide clearance for access to valves and piping specialties.
- G. Install piping so that system can be drained. Where possible, slope to main drain valve. Slope dry pipe and pre-action systems subject to freezing at minimum 1/4"/10' on mains and 1/2"/10' on branches. Where piping not susceptible to freezing cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or ball valve with hose thread outlet and cap for drainage over 5 gallons. Pipe main drain valve to grade or to air gap sewer receptor.
- H. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.
- I. Do not route piping within exterior walls.

- J. Do not route piping through transformer vaults or above transformers, panelboards or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.
- K. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

### **3.02 WELDED PIPE JOINTS**

- A. 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 only for connections up to one-half (1/2) the diameter of the immediate upstream piping.

### **3.03 THREADED PIPE JOINTS**

- A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

### **3.04 MECHANICAL GROOVED PIPE CONNECTIONS**

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

### **3.05 UNIONS AND FLANGES**

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

### **3.06 INSTALLATION OF FIRE SUPPRESSION SYSTEM COMPONENTS**

- A. Install fire suppression system components in accordance with NFPA, product listings and manufacturer's recommendations. Locate where accessible for servicing and replacement.
- B. Sprinkler Heads: Locate sprinklers as indicated on fire protection drawings and reflected ceiling plan maintaining minimum clearances from obstructions, ceilings and walls. Install sprinklers level in locations not subject to spray pattern interference. Provide sprinkler installations below ductwork, soffits, etc.
- C. Select sprinkler temperature rating to not exceed maximum ambient temperature rating allowed under normal conditions at installed location. Provide ordinary temperature (nominally 165°F.) sprinkler except at skylights, adjacent to diffusers, unit heaters, un-insulated heating pipes or ducts, within electrical rooms, elevator equipment rooms, top of elevator hoistways, mechanical rooms, storage rooms, or where otherwise indicated.
- D. Exposure Protection: Specific application window sprinklers shall be used to protect non-operable window openings that are in a fire separation. Install sprinklers on both sides of the window in the fire separation.
- E. Spare Sprinklers: Provide quantity of spare sprinklers as noted below and 1 wrench for each type and temperature range installed. Provide 6 spares per 300 or less installed sprinklers, 12 per 1000 or less and 24 for more than 1000. Provide steel cabinet for storage of sprinklers and wrenches.
- F. Pipe riser main drains, test connections and auxiliary drains, where required, to building exterior or as indicated on drawings. Discharge to plumbing fixtures, including mop basins, is not allowed.
- G. Gauges: Provide a valved pressure gauge in main system riser at inlet and outlet of pump and elsewhere as indicated.
- H. Valves: Properly align piping before installation of valves. Do not support weight of piping system on valve ends. Mount valves in locations which allow access for operation, servicing and replacement. Install all valves with the stem in the upright or horizontal position. Valves installed with the stems down will not be accepted. Provide capped hose thread drain valves to allow draining of each trapped portion of piping.



- I. Dry Valves: Install in vertical position in system riser. Install trim recommended by manufacturer including drain and test valves. Pipe drains to hub or floor drains. Test and adjust operation of valves, alarms, pressure maintenance devices, emergency pull boxes and deluge/pre-action controls.
- J. Air Compressor: Attached to system riser or install on concrete housekeeping pad, leveled and bolted in place. Pipe automatic drain discharge piping to floor drain. Install line size ball valve and check valve in discharge line. Install pressure gauge upstream of ball valve.

**3.07 PIPING SYSTEM LEAK TESTS**

- A. Conduct pressure test with test medium of water. If leaks are found, repair the area with new materials and repeat the test. Caulking will not be acceptable.
- B. Test piping in sections or entire system as required by sequence of construction. Do not conceal pipe until it has been successfully tested. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Entire test must be witnessed by the owner's project representative.
- C. Use clean water and remove air from the piping being tested where possible. Measure and record test pressure at the high point in the system.
- D. Test system at 200 psi for 2 hours showing no leakage. Where system design is in excess of 150 psig, test at a pressure 50 psig above system design pressure.
- E. Modifications to existing systems affecting 20 or fewer sprinklers shall not require testing in excess of system working pressure.
- F. All pressure tests are to be documented on NFPA contractor's material and test certificate forms.

**3.08 CONSTRUCTION VERIFICATION CHECKLISTS**

- A. Contractor is responsible for performing construction verification checklists.

END OF SECTION

**SECTION 22 05 00  
COMMON WORK RESULTS FOR PLUMBING**

**PART 1 – GENERAL**

**1.05 SCOPE OF WORK**

- A. Base Bid: It is the intent of these specifications to provide complete and workable plumbing systems as shown on the accompanying plans and as specified herein except such parts as are specifically exempted herein. Provide all necessary supervision, coordination, labor, materials, equipment, fixtures, drayage, hoisting, tools, transportation, plant services and facilities, machinery and connections to utilities for the installation of complete and operable plumbing systems. If details or special conditions are required in addition to those shown on drawings, provide all material and equipment usually furnished with such systems or required to complete their installation, whether noted in plans and specification or not.
- B. Materials and labor shall be new (unless noted otherwise), first class and workmanlike and shall be subject at all times to the A/E's inspections, tests and approval from the commencement until the acceptance of the completed work.
- C. The layout shown on the drawings is necessarily diagrammatic but shall be followed as closely as other work will permit. The drawings provide design intent. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.
- D. Because of the scale of the Drawings, certain basic items, such as, pipe fittings, duct fittings, access panels, and sleeves, may not be shown. Where such items are required by Code or by other Sections, or where required for proper installation of the Work, such items shall be included, whether shown or not.
- E. In the event of any inconsistencies between the specifications, drawings, contract documents, applicable laws, statutes, ordinances, building codes, rules and regulations, the contractor shall provide the better quality or greater quantity of work and comply with or conform its work to the most stringent legal or contractual requirements.
- F. Changes from these drawings required to make this work conform to the building construction shall be made only with prior written approval of the Architect/Engineer. All proposed changes shall be shown on shop drawings. All measurements shall be verified by actual observation and all work shall fit in place meeting the approval of the Architect/Engineer.
- G. Equipment Specification may not deal individually with minute items required, such as, components, parts, controls, and devices which may be required to produce the equipment performance specified or as required to meet the equipment warranties. Where such items are required to make the system operational, they shall be included by the supplier of the equipment at no additional cost, whether or not specifically called for.

**1.06 SECTION INCLUDES**

- A. This section includes information common to two or more technical plumbing specification sections or items that are of a general nature, not conveniently fitting into other technical sections.
  - 1. Submittals
  - 2. Construction Verification Checklists
  - 3. Functional Performance Tests
  - 4. Reference Standards
  - 5. Quality Assurance
  - 6. Lead Free Requirements
  - 7. Guarantee
  - 8. Equipment Furnished By Others
  - 9. Operation And Maintenance Instructions
  - 10. Record Documents
  - 11. Continuity Of Existing Services
  - 12. Protection Of Finished Surfaces
  - 13. Sealing And Firestopping
  - 14. Off Site Storage

15. Regulatory Requirements
16. Certificates And Inspections
17. Coordination
18. Demolition And Existing Requirements
19. Request And Certification For Payment
20. Sleeves And Openings
21. Omissions
22. Definitions
23. Project/Site Conditions
24. Work Sequence And Scheduling
25. Salvage Materials
26. Training
27. Access Panels And Doors
28. Identification
29. Bedding And Backfill
30. Demolition
31. Excavation And Backfill
32. Concrete Work
33. Cutting And Patching
34. Lintels
35. Building Access
36. Equipment Access
37. Lubrication
38. Housekeeping And Clean Up
39. Sheeting, Shoring And Bracing
40. Dewatering
41. Rock Excavation
42. Surface Restoration

**1.07 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. This section applies to all Division 22 sections of plumbing.

**1.08 SUBMITTALS**

- A. Submit shop drawings for equipment under each section per requirements listed in that section, as well as per Division 1.
- B. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission. Do not submit hard copies of web pages. Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project schedule.
- C. On request from the A/E, the successful bidder shall furnish additional drawings, illustrations, catalog data, performance characteristics, etc.
- D. Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.
- E. The submittals must be approved before fabrication is authorized.
- F. Provide electronic copies of all submittals for review.
- G. Before submitting electrically powered equipment, verify that the electrical power and control requirements for the equipment are in agreement with the motor starter schedule on the electrical drawings. Include a statement on the shop drawing transmittal to the architect/engineer that the equipment submitted and the motor starter schedule is in agreement or indicate any discrepancies.
- H. Not more than two weeks after award of contract but before any shop drawings are submitted, contractor to submit the following plumbing system data sheet. List piping material type for each

pipng service on the project, ASTM number, schedule or pressure class, joint type, manufacturer and model number where appropriate. List valves and specialties for each piping service, fixture and equipment with manufacturer and model number. The approved plumbing system data sheet(s) will be made available to the owner’s project representative for their use on this project.

Plumbing System Data Sheet:

Item	Pipe Service/Sizes	Manufacturer/Model No.	Remarks
Pipe			
Fittings			
Unions			
Valves:			
Pipe Specialties			
Hangers & Supports			
Insulation			
Plumbing Specialties			
Plumbing Fixtures			
Plumbing Equipment			

- I. Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material index list page showing item designation, manufacturer and additional items supplied with the installation. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Include wiring diagrams of electrically powered equipment.
- J. Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:
  - 1. Operating and Maintenance Manuals 2 copies
  - 2. Owner 1 copy
  - 3. Architect/Engineer 2 copies

**1.09 CONSTRUCTION VERIFICATION CHECKLISTS**

- A. Contractor is responsible for utilizing the construction verification checklists supplied under these specifications in accordance with the procedures defined for construction verification checklists in Section 01 91 13 – Commissioning Requirements.

**1.10 FUNCTIONAL PERFORMANCE TESTS**

- A. Contractor is responsible for utilizing the functional performance test procedures supplied under these specifications in accordance with the procedures defined for functional performance test procedures in Section 01 91 13 – Commissioning Requirements.

**1.11 REFERENCE STANDARDS**

- A. Abbreviations of standards organizations referenced in this and other sections are as follows:
  - 1. ABMA American Boiler Manufacturers Association
  - 2. ACPA American Concrete Pipe Association
  - 3. AGA American Gas Association
  - 4. ANSI American National Standards Institute
  - 5. ARI Air Conditioning and Refrigeration Institute
  - 6. ASME American Society of Mechanical Engineers
  - 7. ASPE American Society of Plumbing Engineers
  - 8. ASSE American Society of Sanitary Engineering
  - 9. ASTM American Society for Testing and Materials
  - 10. AWWA American Water Works Association
  - 11. AWS American Welding Society
  - 12. CISPI Cast Iron Soil Pipe Institute
  - 13. CGA Compressed Gas Association
  - 14. CS Commercial Standards, Products Standards Sections, Office of Eng. Standards Service, NBS
  - 15. EPA Environmental Protection Agency

16. FS Federal Specifications, Superintendent of Documents, U.S. Government Printing Office
  17. GAMA Gas Appliance Manufacturers Association
  18. IAPMO International Association of Plumbing & Mechanical Officials
  19. IEEE Institute of Electrical and Electronics Engineers
  20. ISA Instrument Society of America
  21. MICA Midwest Insulation Contractors Association
  22. MSS Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
  23. NBS National Bureau of Standards
  24. NEC National Electric Code
  25. NEMA National Electrical Manufacturers Association
  26. NFPA National Fire Protection Association
  27. NSF National Sanitation Foundation
  28. PDI Plumbing and Drainage Institute
  29. STI Steel Tank Institute
  30. UL Underwriters Laboratories Inc.
- B. Standards referenced in this section:
1. ACI 614 Recommended Practice for Measuring, Mixing and Placing of Concrete
  2. ASTM D1557 Standard Test Method for Moisture-Density Relations of Soils
  3. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops
  4. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
  5. UL1479 Fire Tests of Through-Penetration Firestops
  6. UL723 Surface Burning Characteristics of Building Materials

## 1.12 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Division 1 for equals and substitutions.
1. Where the following conflicts with Division 1, the requirements of Division 1 shall govern.
  2. If the Contractor wishes to submit an alternate to the named manufacturers for any equipment, he may submit a voluntary alternative minimum 7 days prior to bid, stating the manufacturer's name, model number, written, detailed product data.
  3. Where materials or equipment are specified by name the proposed material or equipment must be identical to the specified material or equipment in all characteristics of quality, function and serviceability, regardless of application in the Project and, in addition, when the Architect deems that aesthetic significance is important, the equal material or equipment must be identical in all characteristics of visual appearance, design, color and texture. Any proposed equal shall be submitted to Architect/Engineer for prior approval, which Architect/Engineer may approve or disapprove in its sole discretion. Work performed or constructed with unapproved equals is at Contractor's risk and any required correction of work incorporating unapproved equals shall be at Contractor's sole cost and expense.
  4. In all instances, Contractor shall assume full responsibility for proof of equality of the statute to the equipment hereinafter specified. All data and information necessary for proof of equality, function and space requirements shall be prepared and accompany the submittal of the substitution to the Architect/Engineer. Approval by the Architect/Engineer of equipment other than the specified does NOT relieve Contractor of this responsibility.
- B. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.
- C. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system, including, but not limited to, coordination with other trades and any required changes by other trades and for obtaining the intended performance from the system into which these items are placed.

### **1.13 LEAD FREE REQUIREMENTS**

- A. All materials that contact potable water shall be lead free. Lead free refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content  $\leq 0.25\%$  per the Federal Safe Drinking Water Act as amended January 4<sup>th</sup> 2011 Section 1417.
- B. This requirement applies to all of the subsequent Plumbing Specification Sections and Plumbing Drawings and supersedes any part or model number that may conflict with this requirement.

### **1.14 GUARANTEE**

- A. Refer to Division 1 for guarantees and warranties. In addition to the requirements in Division 1, this Contractor shall meet the following requirements.
- B. In entering into a contract covering this work, the contractor accepts the specifications and guarantees that the work will be carried out in accordance with the requirements of this specification or such modifications as may be made under the contract documents.
- C. Contractor further guarantees that the workmanship and material will be of the best procurable and that none but experienced workmen familiar with each particular class of work will be employed.
- D. Contractor further guarantees to replace and make good at his own expense, including travel time, all defects, which may develop within 1 year after final payment and acceptance by the Architect/Engineer, due to faulty workmanship or material, upon, receipt of written notification from the Owner.

### **1.15 EQUIPMENT FURNISHED BY OTHERS**

- A. Plumbing Contractor is responsible to make all final plumbing connections to kitchen fixtures and equipment supplied by others for a complete and working project. Coordination with general contractor and kitchen equipment supplier is required.

#### **OPERATION AND MAINTENANCE INSTRUCTIONS**

- A. Refer to Division 1 for all operations and maintenance instructions.
- B. In addition to the general content specified under Division 1 supply the following additional documentation:
  - 1. Copies of all approved submittals along with approval letters
  - 2. Records of tests performed to certify compliance with system requirements
  - 3. Manufacturer's wiring diagrams for electrically powered equipment
  - 4. Certificates of inspection by regulatory agencies
  - 5. Valve schedules
  - 6. Lubrication instructions, including list/frequency of lubrication
  - 7. Parts lists for fixtures, equipment, valves and specialties.
  - 8. Manufacturers' installation, operation and maintenance recommendations for fixtures, equipment, valves and specialties.
  - 9. Additional information as indicated in the technical specification sections

### **1.17 RECORD DOCUMENTS**

- A. Refer to Division 1 for record documents.
- B. In addition to the general content specified under Division, follow the following procedures.
  - 1. During the progress of the work, Contractor shall maintain a current (daily) record set of the drawings and specifications, indicating thereon all work installed at variance with such Contract Documents including, without limitation, work covered by Addenda, Field Work Orders, Change Orders and Engineers additional instructions, interpretations and clarification. All changes or deviations from the original layout of the work and all critical dimensions of buried or concealed work shall be recorded. It shall be Contractor's responsibility to assure that said record sets are complete, accurate and up-to-date, Engineer shall have the right to inspect and review such record sets.
  - 2. At the completion of the work, Contractor shall indicated on record sets all record changes and such additional details necessary or appropriate to provide a complete reference document for use by Engineer. If variations and details cannot be shown clearly thereon, the Contractor shall prepare supplemental drawings adequate to impart the information. The foregoing drawings collectively shall constitute the "Record" drawings for the work.

3. All indication on "Record" drawings shall be executed in a legible manner at Contractor's cost, using methods and legend presentations compatible with the overall scheme of the record drawings with respect to scale, drawing sheet sizes and sequential indexing. All changes shall be marked clearly in red and clouded.
4. Engineer may review Contractor's "Record" drawings and notify Contractor of observed discrepancies or deviations. Contractor shall promptly correct discrepancies, deviations or illegible markups at Contractor's expense and resubmit revised drawings for Engineer review.
5. Contractor shall provide final electronic record drawings to the Owner through the Engineer.
6. Engineer will provide final electronic record drawings to the Owner based on Contractor's markups.

#### **1.18 CONTINUITY OF EXISTING SERVICES**

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

#### **1.19 PROTECTION OF FINISHED SURFACES**

- A. Refer to Division 1.

#### **1.20 SEALING AND FIRESTOPPING**

- A. Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.
- B. Contractor shall request current life safety drawings from Architect/Owner.

#### **1.21 OFF SITE STORAGE**

- A. If payment will be requested for approved offsite stored material, then the Contractor shall complete an "Offsite Storage Agreement" which is available from the Owner. Prior approval by Owner's personnel for offsite storage will be needed. No material will be accepted for offsite storage unless submittals for the material have been approved.

#### **1.18 REGULATORY REQUIREMENTS**

- A. Comply with requirements of Wisconsin Administrative Code and local Authority Having Jurisdiction (AHJ) regarding materials and installation.

#### **1.19 CERTIFICATES AND INSPECTIONS**

- A. Refer to Division 1 for permits, regulations, utilities and taxes.
- B. Obtain and pay for all required local or State installation inspections except those provided by the Architect/Engineer in accordance with State code. Deliver originals of these certificates to the Owner. Include copies of the certificates in the Operating and Maintenance Instructions.
- C. Coordinate and provide inspections as required by the Authority Having Jurisdiction over the site.

#### **1.20 COORDINATION**

- A. Refer to Division 1 for coordination. In addition to the requirements specified under Division 1, the following requirements apply.
- B. It shall be the responsibility of each Contractor to coordinate and consult with each other to determine space requirements and to determine that adequate space for servicing is provided for all equipment whether furnished by the Contractor or others. The General Contractor shall have final decision on all space priority conflicts among Contractors. All space priority conflicts shall be brought to the attention of the Architect/Engineer and Owner's Representative.
- C. Each Contractor shall thoroughly familiarize himself with existing systems which will affect and be affected by relocation of existing equipment and installation of new lines and equipment. They shall plan installation of their work so that interruptions of services to any building or portion thereof will be a minimum, and such interruptions shall occur only when system is not required, if possible. If not

possible, each Contractor shall insure the operation of services by whatever means possible, such as, installing bypasses, capping of services, or providing temporary service. Each interruption shall be for as short a duration as possible.

- D. Cooperation among all Contractors shall be required. Any Work that is installed without cooperating or coordinating with other Contractors and is in conflict shall be removed and reinstalled at that particular Contractor's cost. No cost additions to the Project will be considered due to a Contractor's lack of participation in the cooperation and coordination process. The following list of items of Work shall be the priority of order for all Contractors:
  - 1. Structure
  - 2. Recessed light fixtures
  - 3. Gravity-flow systems for sanitary, storm, steam and steam condensate piping
  - 4. Ductwork and appurtenances
  - 5. Electrical and low voltage cable tray
  - 6. Plumbing vent piping
  - 7. Fire protection (sprinkler system)
  - 8. HVAC piping
  - 9. Gas piping, process piping and domestic water
  - 10. Electrical conduit and low voltage conduit
  - 11. Control air lines or conduit
- E. The above list, in descending order, is the precedence assigned the Work items for space priority. Gravity-flow systems have first priority.
- F. Exception: Plumbing lines below or behind plumbing fixtures shall have precedence over all other work. Electrical conduit above or below switchgear, panelboards and control panels shall have precedence over all other work. Do not install any fluid conveying piping over electrical or elevator equipment.
- G. In the case of interconnection of the work of two or more contractors, verify at the site or on shop drawings all dimensions relating to such work. All errors due to the failure to so verify any such dimensions shall be promptly rectified.
- H. Any installed work that is not coordinated and interferes with another contractor's work shall be removed or relocated at the installing contractor's expense.

#### **1.21 DEMOLITION AND EXISTING REQUIREMENTS**

- A. Existing active services: water, gas, medical gas, steam, ventilation, compressed or control air, sanitary waste, sanitary vent, storm electric, and any other building systems when encountered shall be protected against damage. Where existing services are to be abandoned, the services shall be removed back to the point of origin and removed from the site unless otherwise directed by the Owner's Representative.
- B. Submit a "Sequence of Work Schedule" in respect to all temporary and permanent utility and service cutovers after final determination. This schedule shall be submitted for approval to the Owner and Architect/Engineer. The submittal shall designate priority order, service or utility affected, date of cutover, and time of day to start and finish.
- C. Bidders should inspect the site to become familiar with conditions of the site which will affect the Work. Bidders should verify points of connection with utilities, routing of outside piping to include required clearances from any existing structures, or other obstacles.
- D. Extra payment will not be allowed for changes in the Work required because of the successful bidder's failure to make this inspection.

#### **1.22 REQUEST AND CERTIFICATION FOR PAYMENT**

- A. Within 10 days after Notice to Proceed, the successful bidder will submit to the Owner's Project Representative in a form prescribed by Division 1, a cost breakdown of the proposed values for work performed which, if approved by the owner, will become the basis for construction progress and monthly payments. The cost breakdown items shall reflect actual work progress stages as closely as feasible.
- B. In addition, if payment is requested for approved off-site stored material, then that material shall be listed as a line item in the request and certification for payment cost breakdown.



**1.23 SLEEVES AND OPENINGS**

- A. Openings required in new or existing construction that may be necessary for the installation of new work shall be provided by the respective contractor and all patching and repairing shall be done by workmen competent in the trade required, at the expense of the respective contractor. The respective contractor shall be responsible for arranging the work so that minimum cutting will be required. All rubbish and excess materials involved in such cutting shall be promptly removed from the site and disposed of by the contractor. Cutting through the floor or roof systems or load bearing walls shall be done only with the prior written approval of the Architect/Engineer so as to avoid damaging the structural system.

**1.24 OMISSIONS**

- A. No later than ten (10) days before bid opening, the Contractor shall call the attention of the A/E to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

**1.25 DEFINITIONS**

- A. Wherever the words “the Contractor”, “this Contractor” or “Plumbing Contractor” appear in this division, they refer to the Contractor for Plumbing work.
- B. The term “provide” includes such labor, methods, materials, equipment and transportation or other facilities required to complete the Contract and the performance of all duties thereby upon the Contractor.

**1.26 PROJECT/SITE CONDITIONS**

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of A/E before proceeding.
- C. Tools, materials and equipment shall be confined to areas designated by the Owner’s project representative.

**1.27 WORK SEQUENCE AND SCHEDULING**

- A. Install work in phases to accommodate Owner's occupancy requirements. During the construction period coordinate schedule and operations with Owner's Construction Representatives.

**1.28 SALVAGE MATERIALS**

- A. No materials removed from this project shall be reused (except as specifically noted below). All materials removed shall become the property of and shall be disposed of by the Contractor.

**1.29 TRAINING**

- A. The contractor shall have the following responsibilities:
  - 1. Provide a training plan thirty days before the planned training covering the following elements:
    - a. Equipment
    - b. Intended audience
    - c. Location of training
    - d. Objectives
    - e. Subjects covered (description, duration of discussion, special methods, etc.)
    - f. Duration of training on each subject
    - g. Instructor for each subject
    - h. Methods (classroom lecture, manufacturer’s quality video, site walk-through, actual operational demonstrations, written handouts, etc.).
  - 2. Provide designated owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment that makes up the system.
  - 3. Training shall normally start with classroom sessions followed by hands-on demonstration/training on each piece of equipment.

4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system shall be repaired or adjusted as necessary and the demonstration repeated at another scheduled time, if necessary.
  5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
  6. The controls contractor shall attend sessions other than the controls training, as specified, to discuss the interaction of the controls system as it relates to the equipment being discussed.
  7. The training sessions shall follow the outline in the table of contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
  8. Training shall include:
    - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
    - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include startup, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
    - c. Discussion of relevant health and safety issues and concerns.
    - d. Discussion of warranties and guarantees.
    - e. Common troubleshooting problems and solutions.
    - f. Explanatory information included in the O&M manuals.
    - g. Discussion of any peculiarities of equipment installation or operation.
    - h. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.
    - i. Hands-on training shall include startup, operation in all modes possible, including manual, shut-down, alarms, power failure and any emergency procedures, and preventative maintenance for all pieces of equipment.
  9. The contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls not controlled by the central control system.
- B. Provide a minimum of 4 hours of instruction.
- C. Provide additional training as specified in other specification sections for specific equipment.

## **PART 2 – PRODUCTS**

### **2.01 ACCESS PANELS AND DOORS**

- A. Lay-in Ceilings:
  1. Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Division 9 are sufficient; no additional access provisions are required unless specifically indicated.
- B. Concealed Spline Ceilings:
  1. Removable sections of ceiling tile held in position with metal slats or tabs compatible with the ceiling system used will be provided under Division 9.
- C. Metal Pan Ceilings:
  1. Removable sections of ceiling tile held in position by a pressure fit will be provided under Division 9.
- D. Plaster Walls and Ceilings:
  1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public or secured areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the item needing service; minimum size is 12" by 12"

**2.02 IDENTIFICATION**

- A. Manufacturers: EMED Company, W.H. Brady, Seton Nameplate Company, Thor Enterprises, Carlton, MSI Marking Services.
- B. Engraved Name Plates:
  - 1. White letters on a black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting.
- C. Snap-Around Pipe Markers:
  - 1. One-piece, preformed, vinyl construction, snap-around or strap-around pipe markers with applicable labeling and flow direction arrows, 3/4" min. size for lettering. Provide nylon ties on each end of pipe markers.
- D. Valve Tags:
  - 1. Round brass tags with 1/2 inch numbers, 1/4 inch system identification abbreviation, 1-1/4 inch minimum diameter, with brass jack chains, brass "S" hooks or one piece nylon ties around the valve stem.
- E. Underground Warning Tape:
  - 1. Detectable underground warning tape, 5.0 mil overall thickness, 6" width, .0035" thick aluminum foil core with polyethylene jacket bonded to both sides. Color code tape and print caution along with name of buried service in bold letters on face of tape.
  - 2. Underground Tracer Wire:
  - 3. All underground non-metallic sewers/mains and water services/mains shall be provided with tracer wire installations. Tracer wire shall be continuous solid copper or steel plastic coated with split bolt or compression-type connectors.

**2.03 BEDDING AND BACKFILL**

- A. Bedding up to a point 12" inches above the top of the pipe shall be thoroughly compacted sand or crushed stone chips meeting the following gradations:

Gradation for Bedding Sand		Gradation for Crushed Stone Chip Bedding	
Sieve Size	% Passing (by Wt.)	Sieve Size	% Passing (by Wt.)
1 inch	100	1/2 inch	100
No. 16	45 - 80	No. 4	75 - 100
No. 200	2 - 10	No. 100	10 - 25
- B. Backfill above the bedding in lawn areas shall be thoroughly compacted excavated material free of large stones, organic, perishable, and frozen materials.
- C. Backfill above the bedding under existing and future utilities, paving, sidewalks, curbs, roads and buildings shall be granular materials, pit run sand, gravel, or crushed stone, free from large stones, organic, perishable and frozen materials.

**2.04 SLEEVES AND OPENINGS**

- A. General:
  - 1. Pipe sleeves shall be constructed of standard weight ASTM A53 or ASME B36.10 steel with an anchor plate constructed of A36/A36M steel welded to the pipe. The sleeve shall be sized a minimum of 1" larger than piping insulation diameter. The entire assembly shall be hot-dip galvanized after fabrication.
  - 2. Duct sleeves and piping sleeves passing through interior walls shall be constructed of 24 gauge galvanized steel minimum thickness.
- B. Sleeves Through Below Grade Walls:
  - 1. Provide steel pipe sleeve, ASTM A53, pressure sealing with membrane clamp ring, gasket, water stop ring, external rings, and nitrile rubber link seals. The assembly shall be hot-dip galvanized after fabrication.
    - a. Seals: Modular mechanical type seals, consisting of interlocking nitrile rubber links shaped to continuously fill the annular space between the pipe and the sleeve and electrically isolate the carrier pipe from the steel sleeve.
    - b. Sealing Element: Polychloroprene rubber material compounded to resist aging, ozone, sunlight, hydrocarbon gases, water, and chemical action.
    - c. Hardware: Type 300 series stainless steel fasteners. Threads rolled to produce smooth uniform threads and unbroken flow lines.

- d. Compression Plates: Fiberglass-reinforced polyester plastic, injection molded for high physical properties, dielectric strength and non-cold flow creep characteristics, having high resistance to acidic and alkaline soils.
2. For sleeves located 15 feet or more below grade provide cast iron sleeve ASTM A74 with compression seals.

## **2.05 SEALING AND FIRESTOPPING**

- A. Fire and/or Smoke Rated Penetrations:
  1. Manufacturers: 3M, Hilti, Rectorseal, STI/SpecSeal, Tremco.
  2. All firestopping systems shall be provided by the same manufacturer.
  3. Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by the Owner and the Authority Having Jurisdiction (AHJ).
  4. Submittals: Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.
  5. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
  6. Use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop blocks, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.
  7. All sealants shall meet the intent of LEED® VOC requirements, <250 g/L VOC contents (less H<sub>2</sub>O and exempt solvents).
- B. Non-Rated Penetrations:
  1. Pipe Penetrations Through Below Grade Walls: In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water-stop type wall sleeve. The operating bolts of the mechanical type seal shall be accessible from the interior of the building.
  2. Pipe Penetrations: At pipe penetrations of non-rated interior partitions, floors and exterior walls, use urethane caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster or wood partitions where sleeve is not required use urethane caulk in annular space between pipe insulation and wall material.

## **PART 3 – EXECUTION**

### **3.05 DEMOLITION**

- A. Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to be performed adjacent to existing work that remains in an occupied area, construct temporary dust partition to minimize the amount of contamination of the occupied space. Where pipe is removed and not reconnected with new work, cap ends of existing services as if they were new work. Coordinate work with the Owner to minimize disruption to the existing building occupants.
- B. All pipe, fixtures, equipment, wiring and associated conduit, insulation and similar items demolished, abandoned, or deactivated are to be removed from the site by the Contractor except as specifically noted otherwise. All designated equipment is to be turned over to the owner for their use at a place and time so designated. Maintain the condition of material and/or equipment that is indicated to be reused equal to that existing before work began.
- C. All contractors requiring the personnel/ material hoist and or temporary construction elevator (i.e. new elevators, temporarily protected) at times other than outlined in the temporary facilities specifications will make arrangements directly with the general contractor. The general contractor is responsible for all coordination and scheduling of the use of any hoisting equipment so the flow of the project is smoothly maintained and all workers have access to the work areas to perform their work and deliver material to the areas needed according to the project schedule.

- D. If any contractor's work requires the removal and replacement of any finished materials including but not limited to such materials as ceiling tiles, wall finishes, cabinets, doors, flooring, windows, etc. after those items are installed, each contractor will be responsible, at no additional cost to the owner, to replace any damaged, soiled or lost materials with new materials to match the existing materials and those materials damaged.

### **3.02 EXCAVATION AND BACKFILL**

- A. Perform all excavation and backfill work necessary to accomplish indicated plumbing systems installation. Excavate to bottom of pipe and structure bedding, 4" in stable soils, 6" in rock or wet trenches and 8" in unstable soil. Finish bottoms of excavations to true, level surface.
- B. Tunnel or remove sidewalk and curb in areas of excavation to the nearest joint. Remove pavements, curbs and gutters to neat and straight lines to the limits of removal. Make sawcut lines parallel to existing joints, or parallel or perpendicular to pavement edges to form a neat patch. Carefully remove remaining pavement within the sawcut area. Leave existing base materials between the area disturbed by the work and the sawcut line undisturbed by the sawcutting, pavement removal, or pavement replacement processes.
- C. Strip topsoil from area to be excavated, free from subsoil and debris, and store for later respreading.
- D. At no time place excavated materials where they will impede surface drainage unless such drainage is being safely rerouted away from the excavation.
- E. Excavate whatever materials are encountered as required to place at the elevations shown, all pipe, manholes, and other work. Remove debris and rubbish from excavations before placing bedding and backfill material.
- F. Remove surplus excavated materials from site.
- G. Verify the locations of any water, drainage, gas, sewer, electric, telephone or steam lines which may be encountered in the excavation. Underpin and support all lines. Cut off service connections encountered which are to be removed at the limits of the excavation and cap.
- H. Provide and maintain all fencing, barricades, signs, warning lights, and/or other equipment necessary to keep all excavation pits and trenches and the entire subgrade area safe under all circumstances and at all times. No excavation shall be left unattended without adequate protection.
- I. Elevations shown on the plans are subject to such revisions as may be necessary to fit field conditions. No adjustment in compensation will be made for adjustments up to two (2) feet above or below the grades indicated on the plans.
- J. Install lines passing under foundations with minimum of 1-1/2 inch clearance to concrete and insure there is no disturbance of bearing soil.
- K. Bed pipe up to a point 12" above the top of the pipe. Take care during bedding, compaction and backfill not to disturb or damage piping.
- L. Mechanically compact bedding and backfill to prevent settlement. The initial compacted lift to not exceed 24" compacted to 95% density per Modified Proctor Test (ASTM D-1557). Subsequent lifts under pavements, curbs, walks and structures are not to exceed 12" and be compacted to 95% density per Modified Proctor Test. In all other areas where construction above the excavation is not anticipated within 2 years, mechanically compact backfill in lifts not exceeding 24" to 90% density per Modified Proctor Test. Route the equipment over each lift of the material so that the compaction equipment contacts all areas of the surface of the lift.

### **3.03 CONCRETE WORK**

- A. Cast-in-place concrete within the building will be performed by the Division 3 Contractor unless otherwise noted. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for support or installation of plumbing piping, fixtures, specialties and equipment. Coordinate locations of equipment, pipe penetrations in wet areas, etc. with the Division 3 Contractor.
- B. Plumbing related cast-in-place concrete on the exterior of the building to be provided by this Contractor in conformance with requirements of Division 3. This includes piping thrust restraints, pipe supports, hydrant supports, manholes, catch basins, grease traps, septic tanks, distribution boxes, valve pits, meter pits, cleanout cover pads, yard hydrant pads, etc.

### **3.04 CUTTING AND PATCHING**

- A. Refer to Division 1 for cutting and patching. In addition to the requirements in Division 1:
- B. Each Contractor shall coordinate the placing of openings in the new structure as required for the installation of each Contractor's work.
- C. Each Contractor shall furnish to the General Contractor the accurate locations and sizes for required openings in the new work, but this shall not relieve each Contractor of the responsibility of checking to assure that properly sized openings are provided. When additional patching is required due to the Contractor's failure to inspect this work, then the Contractor shall make arrangements for the patching required to properly close the openings to include patch painting, and the Contractor shall pay any additional cost incurred in this respect.
- D. If cutting and patching of the new structure is made necessary due to the Contractor's failure to install piping, ducts, sleeves, or equipment on schedule, or due to the Contractor's failure to furnish on schedule the information required for the leaving of openings, then it shall be the Contractor's responsibility to make arrangements and obtain approval from the General Contractor and Architect/Engineer for this cutting and patching, and the Contractor shall pay any additional cost incurred in this respect. The Contractor shall also reimburse the Owner for any additional costs incurred to the Architect/Engineer for additional services caused by the Contractor in this respect.
- E. The Contractor shall provide cutting and patching and patch painting in the existing structure as required for the installation of his Work and shall furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Architect/Engineer. Extent of cutting shall be minimized; use core drills, power saws, or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

### **3.05 LINTELS**

- A. This contractor shall design, fabricate, and install all lintels required in masonry walls for duct and pipe penetrations.

### **3.06 BUILDING ACCESS**

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

### **3.07 EQUIPMENT ACCESS**

- A. Install all piping, conduit and accessories to permit access to equipment for maintenance and service. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Access doors in general construction are to be furnished by the Plumbing Contractor and installed by the General Contractor.
- B. Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not require access panels.

### **3.08 COORDINATION**

- A. Coordinate all work with other contractors prior to installation. Any work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
- B. Verify that all devices are compatible for the type of construction and surfaces on which they will be used.

### **3.09 IDENTIFICATION**

- A. Identify interior piping not less than once every 30 feet, not less than once in each room, adjacent to each access door or panel, and on both side of the partition where accessible piping passes through walls or floors. Place flow directional arrows at each pipe identification location.
- B. Identify all exterior buried piping for entire length with underground warning tape except for sewer piping which is routed in straight lines between manholes or cleanouts. Place tape 6"-12" below finished grade along entire length of pipe. Extend tape to surface at building entrances, meters, hydrants

and valves. Where existing underground warning tape is broken during excavation, replace with new tape identifying appropriate service and securely spliced to ends of existing tape.

- C. Identify valves with brass tags bearing a system identification and a valve sequence number. Identify medical gas and vacuum valves with brass tags and wall or cabinet mounted color coded engraved nameplate with the following "(Type of Gas) Shutoff Valve for (Location or Zone)". Valve tags are not required at a terminal device unless the valves are greater than ten feet from the device, located in another room or not visible from device. Provide a typewritten valve schedule and pipe identification schedule indicating the valve number and the equipment or areas supplied by each valve and the symbols used for pipe identification; locate schedules in mechanical room and in each Operating and Maintenance manual. Schedule in mechanical room to be framed under clear plastic.

### **3.10 LUBRICATION**

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

### **3.11 SLEEVES AND OPENINGS**

- A. General:
  - 1. Sleeves are not required for piping and ducts passing through interior non-rated drywall, plaster, or wood partitions and interior poured concrete walls that have been saw cut or core drilled.
  - 2. Pack annular space between sleeves and pipe or ducts with fiberglass insulation and seal.
  - 3. Piping sleeves that pass through fire rated floors, walls, or ceilings shall be provided with a UL listed fire stop material meeting UL 1479 to seal the opening between the pipe and the pipe sleeve to maintain the fire rating.
  - 4. Provide escutcheon plates on piping to cover sleeve and insulation in finished areas.
  - 5. Refer to Division 1, General Requirements for additional information on sleeves and openings.
- B. Sleeves Through Floors/Ceilings:
  - 1. Sleeves shall be installed to extend 1 inch above finished floor with a watertight sealant between floor and sleeve in all mechanical rooms and wet rooms listed below.
  - 2. If a sleeve is not provided, provide 1-1/2 inch angle ring with urethane caulk between the angle and the floor and seal at the corners to form a watertight seal.
    - a. Wet Locations:
      - 1) Mechanical Rooms
      - 2) Chemical storage and hazardous waste storage rooms
      - 3) Food service/kitchen areas (behind/under equipment, cabinets, tables, etc.)

### **3.12 SEALING AND FIRESTOPPING**

- A. The Contractor shall refer to building life safety drawings for all smoke and fire rates in addition to the mechanical drawings. Any discrepancies shall be brought to the attention of the Architect/Engineer before final addendum.
- B. Fire And/Or Smoke Rated Penetrations:
  - 1. Install approved product in accordance with the manufacturer's instructions where pipes penetrate a fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the insulation and vapor barrier.
  - 2. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any substantial weight.
- C. Non-Rated Partitions:
  - 1. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe and tighten in place, in accordance with manufacturer's instructions.
  - 2. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.

**3.13 HOUSEKEEPING AND CLEAN UP**

- A. The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

**3.14 SHEETING, SHORING AND BRACING**

- A. Provide shoring, sheet piling and bracing in conformance with the Building Code to prevent earth from caving or washing into the excavation. Shore and underpin to properly support adjacent or adjoining structures. Abandon in place shoring, sheet piling and underpinning below the top of the pipe, or, if approved in advance by the engineer, maintained in place until other permanent support approved by the engineer is provided.

**3.15 DEWATERING**

- A. Provide, operate and maintain all pumps and other equipment necessary to drain and keep all excavation pits, trenches and the entire subgrade area free from water under all circumstances. Obtain permit from the Wisconsin Department of Natural Resources district office for discharge of construction dewatering effluent.

**3.16 ROCK EXCAVATION**

- A. Remove rock encountered in the excavation to a minimum dimension of six (6) inches outside the pipe. Rock excavation includes all hard, solid rock in ledges, bedded deposits and unstratified masses, all natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock; which material is so hard or so firmly cemented that in the opinion of the Engineer it is not practical to excavate and remove same with a power shovel except after thorough and continuous drilling and blasting. Rock excavation includes rock boulders of 1/2 cubic yard or more in volume.
- B. Rock excavation will be computed on the basis of the depth of rock removed and a trench width two (2) feet larger than the outside diameter of the pipe where one (1) pipe is laid in the trench and three (3) feet larger than the combined outside diameter where two (2) pipes are laid in the trench. Include 6" pipe and structure bedding in rock excavation. Include rock excavation shown on the plans in the Base Bid.

**3.17 SURFACE RESTORATION**

- A. Completely restore the surface of all disturbed areas to a like condition of the surface prior to the work. Level off all waste disposal areas and clean up all areas used for the storage of materials or the temporary deposit of excavated earth. Remove all surplus material, tools and equipment.

END OF SECTION



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**SECTION 22 05 13**  
**COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Unless noted otherwise, the Plumbing Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes requirements for single and three phase motors that are used with equipment specified in other sections.
  - 1. Single Phase, Single Speed Motors

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 22 30 00 – Plumbing Equipment for equipment requiring motors.
- C. Section 22 42 00 – Commercial Plumbing Fixtures.
- D. Division 26 – Electrical – Electrical for power wiring, starters, and other electrical devices

**1.04 SUBMITTALS**

- A. Refer to Section 22 05 00 – Common Work Results for Plumbing, Submittals. In addition to the general content specified under Section 22 05 00 – Common Work Results for Plumbing, supply the following submittals:
  - 1. Single Phase, Single Speed Motors
- B. Include with the equipment which the motor drives the following motor information: motor manufacturer, voltage, phase, hertz, rpm, full load efficiency, full load power factor, service factor, NEMA design designation, insulation class, and frame type.

**1.05 REFERENCE STANDARDS**

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

**1.06 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified in Section 22 05 00 – Common Work Results for Plumbing.

**1.07 ELECTRICAL COORDINATION**

- A. All starters, disconnects, relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment are provided by the Electrical Contractor, except as specifically noted elsewhere in this division of specifications.
- B. Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this Contractor, together with their actuating devices if these devices are furnished by the Electrical Contractor. Should any discrepancy in size, horsepower rating, electrical characteristics or means of control be made to any motor or other electrical equipment after contracts are awarded, Contractor is to immediately notify the architect/engineer of such discrepancy. Costs involved in any changes required due to equipment substitutions initiated by this contractor will be the responsibility of this contractor.
- C. The Electrical Contractor will provide all power wiring and the Plumbing Contractor will provide all control wiring. Control wiring shall conform to Division 16 requirements for Control Wiring.
- D. Furnish project specific wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and indicated to be wired by the Electrical Contractor.

**1.08 PRODUCT CRITERIA**

- A. Motors to conform to all applicable requirements of NEMA, IEEE, ANSI, and NEC standards and shall be listed by U.L. for the service specified.
- B. Select motors for conditions in which they will be required to perform; i.e., general purpose, splashproof, explosion proof, standard duty, high torque or any other special type as required by the equipment or motor manufacturer's recommendations.
- C. Furnish motors for starting in accordance with utility requirements and compatible with starters as specified.

**PART 2 – PRODUCTS**

**2.01 SINGLE PHASE, SINGLE SPEED MOTORS**

- A. Use NEMA rated 115 volt, single phase, 60 hertz motors for all motors 1/3 HP and smaller.
- B. Use permanent split capacitor or capacitor start, induction run motors equipped with permanently lubricated and sealed ball or sleeve bearings and Class A insulation. Service factor to be not less than 1.35.

**PART 3 – EXECUTION**

**3.01 INSTALLATION**

- A. Verify the proper rotation of each three-phase motor as it is being wired or before the motor is energized for any reason.
- B. Lubricate all motors requiring lubrication.

END OF SECTION

**SECTION 22 05 14  
PLUMBING SPECIALTIES**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Unless noted otherwise, the Plumbing Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes specifications for floor drains, roof drains, cleanouts, backflow preventers, water hammer arrestors and other miscellaneous plumbing specialties.
  - 1. Floor Drains
  - 2. Floor Sinks
  - 3. Hub Drains
  - 4. Cleanouts
  - 5. Water Hammer Arrestors
  - 6. Backflow Preventers
  - 7. Trap Guards
  - 8. Vent Flashings

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Section 22 05 23 – General-Duty Valves for Plumbing Piping
- C. Section 22 11 00 – Facility Water Distribution
- D. Section 22 13 00 – Facility Sanitary Sewerage
- E. Section 22 14 00 – Facility Storm Drainage

**1.04 SUBMITTALS**

- A. Refer to Section 22 05 00 – Common Work Results for Plumbing. In addition to the general content specified under Section 22 05 00 – Common Work Results for Plumbing, supply the following submittals:
  - 1. Floor Drains
  - 2. Floor Sinks
  - 3. Hub Drains
  - 4. Cleanouts
  - 5. Water Hammer Arrestors
  - 6. Backflow Preventers
  - 7. Trap Guards
  - 8. Vent Flashings
- B. Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

**1.05 REFERENCE STANDARDS**

- A. ANSI A112.21.1 - Floor Drains.
- B. ANSI A112.26.1/PDI WH-201 - Water Hammer Arrestors.
- C. ASSE 1001 - Pipe Applied Atmospheric Type Vacuum Breakers.
- D. ASSE 1010 - Water Hammer Arrestors.
- E. ASSE 1011 - Hose Connection Vacuum Breakers.
- F. ASSE 1012 - Backflow Preventers with Intermediate Atmospheric Vent.
- G. ASSE 1013 - Reduced Pressure Principle Backflow Preventers.
- H. ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining, Anti-Backflow Type.

## **1.06 QUALITY ASSURANCE**

- A. Substitution of Materials: Refer to Division 1.
- B. Plumbing products requiring approval by the State of Wisconsin Dept. of Safety & Professional Services must be approved or have pending approval at the time of shop drawing submission.

## **1.07 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified in Section 22 05 00 – Common Work Results for Plumbing.

## **PART 2 – PRODUCTS**

### **2.01 FLOOR DRAINS**

- A. Manufacturer: Josam, Smith, Wade, Watts, Zurn
- B. Floor Drains:
  - 1. FD-1: enameled cast iron two piece body with bottom outlet, double drainage flange, weep holes, reversible clamping adjustable collar, adjustable 6"x6" min. square or round polished nickel-bronze strainer with threaded collar. Outlet size as indicated on drawings. Zurn ZN-415-S or B.
  - 2. FD-1A: same as FD-1 with the addition of trap guard.

### **2.02 FLOOR SINKS**

- A. Manufacturer: Josam, Smith, Wade, Watts, Zurn
- B. FS-1: cast iron body, 8" x 8" x 6" deep with white epoxy enameled coated interior and square slotted medium duty top grate, with aluminum interior bottom dome strainer, with anchor flange and/or seepage holes and clamping collar for above grade installation. Outlet size as indicated on drawings. Zurn Z-1910 (KC).

### **2.03 HUB DRAINS**

- A. Manufacturer: Josam, Smith, Wade, Watts, Zurn
- B. HD-1: 7" diameter cast iron indirect waste funnel with acid resistant epoxy coating, bottom outlet, and full-sized p-trap. Outlet size as indicated on drawings. Zurn Z-326-AR.
- C. HD-1A: same as HD-1 with the addition of trap guard.

### **2.04 CLEANOUTS**

- A. Manufacturer: Josam, Smith, Wade, Watts, Zurn
- B. Interior Concrete Floor Areas: Enameled cast iron body with round or square adjustable scoriated polished nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400- / ZN-1400-T.
- C. Interior Ceramic Tile Floor Areas: Enameled cast iron body with square adjustable scoriated nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400-T.
- D. Interior Vinyl Tile Floor Areas: Enameled cast iron body with round adjustable scoriated nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400.
- E. Interior Carpeted Floor Areas: Enameled cast iron body with round adjustable scoriated nickel bronze cover and secured carpet marker, tapered threaded ABS closure plug. Zurn Z-1400-CM.
- F. Interior Finished Wall Areas: Line type cleanout tee with tapered threaded ABS cleanout plug, round polished stainless steel access cover secured with machine screw. Zurn Z-1446- ( Note: Screw shall not pass completely through the ABS plug, trim screw as necessary )
- G. Interior Exposed Vertical Stacks: Line type cleanout tee with tapered threaded ABS closure plug. Zurn Z-1445.
- H. Interior Horizontal Lines: Cast iron hub with tapped ferrule and tapered threaded ABS or PVC closure plug, or no-hub coupling and blind plug.
- I. Exterior (Yard): Schedule 40 PVC frost sleeve and access cover, sized to fit over a 6" diameter cleanout riser, 48" long. Stamp access cover with "SAN" or "ST" legend. Plumbing Creations PVC-48-8.

## **2.05 WATER HAMMER ARRESTORS**

- A. Manufacturer: PPP Industries, Sioux Chief, Wade, Watts
- B. 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. Watts series 15.

## **2.06 BACKFLOW PREVENTERS**

- A. Manufacturers: Cash-Acme, Cla-Val, Conbraco, Febco, Watts, Wilkins
- B. Hose Connection Vacuum Breakers: ASSE 1011, brass or bronze construction, EPDM diaphragm and seat, rated for 125 psig and 180°F. Watts 8 (interior application).
- C. Pipe Applied Atmospheric Type Vacuum Breakers: ASSE 1001, same size as pipe, brass or bronze construction, silicone disc, rated for 125 psig and 160°F. Watts 288A.
- D. Dual Check with Atmospheric Vent for CO<sup>2</sup> Post Mix Vending Machines: ASSE 1022, 3/8", stainless steel body and parts, dual check with third ball check outlet, rated for 150 psig and 140oF. Watts SD-3.
- E. Anti-Siphon Pressure Type Vacuum Breakers: ASSE 1020, same size as pipe, brass or bronze construction, silicone disc, plastic seat, stainless steel spring, inlet and outlet ball shutoff valves, test port ball valves, rated for 150 psig and 110°F. Watts 800M4QT
- F. High Hazard Anti-Siphon, Anti-Spill Vacuum Breakers: ASSE 1056, same size as pipe, brass or bronze construction, silicone rubber discs, stainless steel springs, inlet and outlet ball shutoff valves, with test cocks, anti-spill design, rated for 150 psig and 180° F max.. Watts 008QT.
- G. Intermediate Atmospheric Vented Backflow Preventers: ASSE 1012, same size as pipe, with intermediate atmospheric vent between independent check valves, bronze body with union ends, stainless steel springs, rated for 175 psig and 210° F. Watts 9DM.
- H. Reduced Pressure Zone Backflow Preventers: ASSE 1013 –reduced pressure zone backflow assembly complete with inlet strainer, inlet and outlet ball or non-rising stem gate isolation valves. Size for maximum pressure drop of 10 psig. Constructed 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. Watts series 909-S-QT-AG/909-S-NRS.

## **2.07 TRAP GUARDS**

- A. Manufacturers: ProSet Systems Trap Guard, Sure Seal, Mifab
- B. Flexible elastomeric PVC construction diaphragm trap guard for installation in new and existing floor drains, hub drains, and trench drains. Trap guard to prevent trap evaporation and waste backflow. Size as applicable to the drain outlet size.

## **2.08 VENT FLASHINGS**

- A. Manufacturers: Semco, Oatey
- B. Formed 3 lb. /sq. ft. lead flashing with minimum base size of 15"x17".
- C. Single Ply Membrane Roofs: Flashing boot of material compatible with roofing membrane with base flange for adhering to membrane and stainless steel drawband for securing to vent pipe.

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. Coordinate location and setting of plumbing specialties with adjacent construction. Install in accordance with manufacturers recommendations.
- B. Set floor drains level and plumb adjusted to finished floor elevation. Locate where serviceable.
- C. Set cleanouts level and plumb adjusted to finished floor elevation or finished wall location. Locate where serviceable. Allow minimum of 18" clearance around cleanouts for rodding. Lubricate threaded cleanout plugs with graphite and oil, Teflon tape or waterproof grease.
- D. Install trap guards where indicated.

- E. Provide deep seal traps on floor drains and hub drains installed in mechanical rooms, penthouses or rooms with excessive positive or negative pressure.
- F. Floor drains and hub drains installed in public restrooms, locker rooms, seldom used rooms, and areas with minute drainage flow shall have installations of trap guards.
- G. Install water hammer arrestors where indicated and at quick closing valve installations.
- H. Install backflow preventers in accordance with Wisconsin Department of Safety & Professional Services requirements maintaining minimum clearance distances for servicing and testing. Provide indirect waste piping with air gap installation from relief opening to above hub drain or floor drain.
- I. Where backflow preventers requiring Department of Safety & Professional Services registration are installed, obtain Regulated Object ID Number from the plumbing approval letter and provide initial testing and report filing required by Department of Safety & Professional Services.
- J. Flash vent penetrations through roof. Turn down top of lead flashing into vent pipe. Tighten drawband of membrane boot to vent pipe. Adhere base flashing to deck or membrane. Provide waterproof patch around penetration on existing roofs.

**3.02 CONSTRUCTION VERIFICATION CHECKLISTS**

- A. Contractor is responsible for completing construction verification checklists.

END OF SECTION

**SECTION 22 05 15  
PIPING SPECIALTIES**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Unless noted otherwise, the Plumbing Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section contains specifications for plumbing piping specialties for all piping systems.
  - 1. Thermometers
  - 2. Thermometer Sockets
  - 3. Test Wells
  - 4. Test Plugs
  - 5. Pressure Gauges
  - 6. Strainers
  - 7. Water Flow Meters

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 22 05 23 – General-Duty Valves for Plumbing Piping
- C. Section 22 07 00 – Plumbing Insulation
- D. Section 22 11 00 – Facility Water Distribution
- E. Section 22 30 00 – Plumbing Equipment

**1.04 SUBMITTALS**

- A. Refer to Section 22 05 00 – Common Work Results for Plumbing, Submittals. In addition to the general content specified under Section 22 05 00 – Common Work Results for Plumbing, supply the following submittals:
  - 1. Thermometers
  - 2. Thermometer Sockets
  - 3. Test Wells
  - 4. Test Plugs
  - 5. Pressure Gauges
  - 6. Strainers
  - 7. Water Flow Meters
- B. Include materials of construction, dimensional data, ratings/capacities/ranges, approvals, test data, pressure drop data where appropriate, and identification as referenced in this section and/or on the drawings.

**1.05 REFERENCE STANDARDS**

- A. ASTM B650 Electrodeposited Engineering Chromium Coatings on Ferrous Substrates

**1.06 QUALITY ASSURANCE**

- A. Substitution of Materials: Division 1.

**1.07 DESIGN CRITERIA**

- A. All piping specialties are to be rated for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

**1.08 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified in Section 22 05 00 – Common Work Results for Plumbing.



## **PART 2 – PRODUCTS**

### **2.01 THERMOMETERS**

- A. Ashcroft, Marsh, Taylor, H. O. Trerice, Ametek/U. S. Gauge, Weiss, Wika, Weksler
- B. Stem Type: Cast aluminum case, nine inch scale, clear acrylic window. adjustable angle brass stem with stem of sufficient length so the end of the stem is near the middle of a pipe without reducing the thickness of any insulation, red indicating fluid, black lettering against a white background, with scale ranges as follows:

Service	Hot Water
Scale Range, °F	30 - 180
Increment, °F	2

### **2.02 THERMOMETER SOCKETS**

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

### **2.03 TEST WELLS**

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

### **2.04 TEST PLUGS**

- A. Brass threaded pressure and temperature test plug with neoprene self-closing valve, valve retainer, brass threaded cap, rated for 150 psi and 0-200 degrees F.

### **2.05 PRESSURE GAUGES**

- A. Ametek/U. S. Gauge, Ashcroft, Marsh, Taylor, H. O. Trerice, Weiss, Wika, Weksler
- B. Cast aluminum case of not less than 4.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor bronze bourdon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale, with scale range as follows:

Service	Hot Water	Cold Water
Scale Range, psig	0-100	0-100
Increment, psig	1	1
- C. Pressure Snubbers: Bronze construction, 300 psig working pressure, 1/4" size.
- D. Gauge Valves: Use ball valves as specified in Section 22 05 23 - General-Duty Valves for Plumbing Piping.

### **2.06 STRAINERS**

- A. Armstrong, Illinois, Keckley, Metraflex, Mueller Steam, Sarco, Watts.
- B. Y type; cast bronze body, ASTM B62; 20 mesh stainless steel screens; bolted or threaded screen retainer tapped for a blowoff valve; sweat, threaded or flanged body rated at not less than 150 psi WOG.
- C. Y type; cast iron body, ASTM A126; 20 mesh stainless steel screens; bolted or threaded screen retainer tapped for a blowoff valve; threaded or flanged ends; rated at not less than 150 psi WOG.

### **2.07 WATER FLOW METERS**

- A. Manufacturers: Hedland, Omega.
- B. Direct reading water flow meter for potable water use with polysulfone plastic body, piston and cone, stainless steel spring, Buna N flow indicator ring and pressure seals, polycarbonate limit indicators, NPT or sweat brass fittings, 5% +/- accuracy over full scale and rated for 325 psi and 250° F maximum temperature. Flow meter shall be full line size.

## **PART 3 – EXECUTION**

### **3.01 THERMOMETERS**

- A. Stem Type: Install in piping systems as indicated on the drawings and/or details using a separable socket in each location.

### **3.02 THERMOMETER SOCKETS**

- A. Install at each point where a thermometer or temperature control sensing element is located in a pipeline.

### **3.03 TEST WELLS**

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

### **3.04 TEST PLUGS**

- A. Install in piping systems as indicated on the drawings and/or details wherever provisions are needed for short-term measurement of pressure or temperature.

### **3.05 PRESSURE GAUGES**

- A. Install in locations where indicated on the drawings and/or details, with scale range appropriate to the system operating pressures.
- B. Pressure Snubbers: Install in gauge piping for all gauges used on water services.
- C. Gauge Valves: Install at each gauge location as close to the main as possible and at each location where a gauge tapping is indicated.

### **3.06 STRAINERS**

- A. Install all strainers where indicated allowing sufficient space for the screens to be removed. Install a ball valve in the tapped screen retainer.

### **3.07 WATER FLOW METERS**

- A. Install in hot water return piping as indicated on the drawings. Install in accordance with manufacturer's recommendations. Inlet and outlet piping must be properly aligned to minimize structural stress on the meter body.
- B. Install meter body so scale can be conveniently read.

END OF SECTION

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**SECTION 22 05 23**  
**GENERAL DUTY VALVES FOR PLUMBING PIPING**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Unless noted otherwise, the Plumbing Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes valve specifications for all Plumbing systems except where indicated under Related Work.
  - 1. Water System Valves
    - a. Ball Valves
    - b. Swing Check Valves
    - c. Balancing Valves
    - d. Drain Valves
    - e. Spring Loaded Check Valves
  - 2. Specialty Valves And Valve Accessories
    - a. Gauge Valves

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 22 05 14 – Plumbing Specialties
- C. Section 22 11 00 – Facility Water Distribution
- D. Section 22 13 00 – Facility Sanitary Sewerage
- E. Section 22 14 00 – Facility Storm Drainage
- F. Section 22 30 00 – Plumbing Equipment

**1.04 SUBMITTALS**

- A. Refer to Section 22 05 00 – Common Work Results for Plumbing, Submittals. In addition to the general content specified under Section 22 05 00 – Common Work Results for Plumbing, supply the following submittals:
  - 1. Water System Valves
    - a. Ball Valves
    - b. Swing Check Valves
    - c. Balancing Valves
    - d. Drain Valves
    - e. Spring Loaded Check Valves
  - 2. Specialty Valves And Valve Accessories
    - a. Gauge Valves
- B. Schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves to be used on the project. Temperature ratings specified are for continuous operation.

**1.05 QUALITY ASSURANCE**

- A. Substitution of Materials: Refer to Division 1.

**1.06 DESIGN CRITERIA**

- A. Where valve types (ball, butterfly, etc.) are specified for individual plumbing services (i.e. domestic water, gas, etc.), each valve type shall be of the same manufacturer unless prior written approval is obtained from the Owner.
- B. Valves to be line size unless specifically noted otherwise.

### **1.07 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified in Section 22 05 00 – Common Work Results for Plumbing.

## **PART 2 - PRODUCTS**

### **2.01 WATER SYSTEM VALVES**

- A. Manufacturers: Apollo, Asco, Conbraco, Crane, Hammond, Jomar, Milwaukee Valve, Nibco, Stockham, Watts
- B. All water system valves to be rated at not less than 125 water working pressure at 240 degrees F unless noted otherwise.
- C. Ball Valves:
  - 1. Two or three piece bronze body; sweat ends, stainless steel ball; glass filled Teflon seat; Teflon packing and threaded packing nut; blowout-proof stem; 600 psig WOG. Provide valve stem extensions for valves installed in all piping with insulation.
    - a. 2" and smaller: Nibco, S-585-70-66
    - b. 3": Nibco G-590-Y-66
- D. Swing Check Valves:
  - 1. 3" and smaller: Bronze body, sweat ends, Y-pattern, regrindable bronze seat, renewable bronze disc, Class 125, suitable for installation in a horizontal or vertical line with flow upward. Nibco S413B
- E. Balancing Valves:
  - 1. 2" and smaller: Bronze body with sweat or threaded ends, brass ball, glass filled Teflon seat, capped read-out ports, tapped drain/purge port, and adjustable memory stop position indicator, rated for 200 psig water working pressure at 250°F minimum. Bell & Gossett CB Series
- F. Drain Valves:
  - 1. ¾" ball valve with integral threaded hose adapter, sweat or threaded inlet connections, with threaded cap and chain on hose threads. Watts B-6000-CC/B-6001-CC series
- G. Spring Loaded Check Valves:
  - 1. 2" and smaller: Bronze body, sweat or threaded ends, bronze trim, stainless steel spring, stainless steel center guide pin, Class 125, Teflon seat unless only bronze available. Nibco S480Y
  - 2. 2-1/2" and larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required, Class 125. Nibco W910 or F910

### **2.02 SPECIALTY VALVES AND VALVE ACCESSORIES**

- A. Gauge Valves: Use 1/4" ball valves. Needle valves and gauge cocks will not be accepted.

## **PART 3 – EXECUTION**

### **3.01 GENERAL**

- A. Properly align piping before installation of valves. Install and test valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends.
- B. Mount valves in locations which allow access for operation, servicing and replacement.
- C. Provide valve handle extensions for all valves installed in insulated piping.
- D. Install all valves with the stem in the upright or horizontal position. If possible, install butterfly valves with the stem in the horizontal position. Valves installed with the stems down will not be accepted.
- E. Prior to flushing of piping systems, place all valves in the full-open position.

### **3.02 SHUT OFF VALVES**

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

**3.03 BALANCING VALVES**

- A. Install where indicated on the drawings and details for balancing of flow in pumped hot water recirculation piping systems.
- B. Upon project completion, adjust each valve and set position stop. Balance system to minimum flow in return piping branches needed to maintain even supply water temperature throughout building.

**3.04 DRAIN VALVES**

- A. Provide drain valves for complete drainage of all systems. Locations of drain valves include low points of piping systems, downstream of riser isolation valves, equipment locations specified or detailed, other locations required for drainage of systems and elsewhere as indicated.
- B. Install additional drain valves as appropriate to facilitate winter drain down.

**3.05 SPRING LOADED CHECK VALVES**

- A. Install a spring loaded check valve in each circulating pump discharge line, each clearwater sump pump discharge line and elsewhere as indicated.

**3.06 SWING CHECK VALVES**

- A. Install swing check valves in recirculation branch lines and elsewhere as indicated. Provide weighted swing check valves at sanitary sump pump discharges.

END OF SECTION

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**SECTION 22 05 29**  
**HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Unless noted otherwise, the Plumbing Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes specifications for supports of all plumbing equipment and materials as well as piping system anchors.
  - 1. Structural Supports
  - 2. Pipe Hangers And Supports
  - 3. Pipe Hanger Rods
  - 4. Beam Clamps
  - 5. Concrete Inserts
  - 6. Continuous Concrete Insert Channels
  - 7. Anchors
  - 8. Equipment Stands
  - 9. Corrosive Atmosphere Coatings

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Section 03 10 00 – Concrete Formwork for equipment pads
- C. Section 03 30 00 – Cast-in-Place Concrete for equipment pads
- D. Section 22 07 00 – Plumbing Insulation for insulation protection at support devices

**1.04 SUBMITTALS**

- A. Refer to Section 22 05 00 – Common Work Results for Plumbing. In addition to the general content specified under Section 22 05 00 – Common Work Results for Plumbing, supply the following submittals:
  - 1. Structural Supports
  - 2. Pipe Hangers And Supports
  - 3. Pipe Hanger Rods
  - 4. Beam Clamps
  - 5. Concrete Inserts
  - 6. Continuous Concrete Insert Channels
  - 7. Anchors
  - 8. Equipment Stands
  - 9. Corrosive Atmosphere Coatings
- B. Schedule of all hanger and support devices indicating attachment methods and type of device for each pipe size and type of service.
- C. All submittals are to comply with submission and content requirements specified within Section 22 05 00 – Common Work Results for Plumbing.

**1.05 REFERENCE STANDARDS**

- A. MSS SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture
- B. MSS SP-69 Pipe Hangers and Supports - Selection and Application

**1.06 QUALITY ASSURANCE**

- A. Substitution of Materials: Refer to Division 1.



### **1.07 DESCRIPTION**

- A. Provide all supporting devices as required for the installation of plumbing equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for building piping.
- B. Do not hang any plumbing item directly from a metal deck or run piping so its rests on the bottom chord of any truss or joist.
- C. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.
- D. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.
- E. Protect insulation at all hanger points; see Related Work above.

### **1.08 DESIGN CRITERIA**

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

## **PART 2 – PRODUCTS**

### **2.01 STRUCTURAL SUPPORTS**

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

### **2.02 PIPE HANGERS AND SUPPORTS**

- A. Manufacturers: Anvil, B-Line, Grinnell, Pate, Piping Technology, Roof Products & Systems.
- B. Hangers for Pipe Sizes 1/2" through 2":
  - 1. Carbon steel, adjustable swivel ring.
  - 2. Carbon steel, adjustable clevis, standard.
- C. Hangers for Pipe Sizes 2" and Larger:
  - 1. Carbon steel, adjustable clevis, standard.
- D. Multiple or Trapeze Hangers:
  - 1. Steel channels with welded spacers and hanger rods.
- E. Wall Support:
  - 1. Carbon steel welded bracket with hanger.
  - 2. Perforated, epoxy painted finish, 16-12 gauge, min., steel channels securely anchored to wall structure, with interlocking, split-type, bolt secured, galvanized pipe/tubing clamps. When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp.
- F. Floor Support:
  - 1. Carbon steel pipe saddle, stand and bolted floor flange.
- G. Copper Pipe Supports:
  - 1. All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or polyvinylchloride coated. Where steel channels are used, provide isolation collar between supports/clamps/fasteners and copper piping.

### **2.03 PIPE HANGER RODS**

- A. Steel Hanger Rods:
  - 1. Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.
  - 2. Size rods for individual hangers and trapeze support as indicated in the following schedule.
  - 3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

Maximum Load (Lbs.) (650°F Maximum Temp.)	Rod Diameter (inches)
610	3/8
1130	1/2

#### **2.04 BEAM CLAMPS**

- A. MSS SP-69 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a retaining ring and threaded rod of 3/8, 1/2, and 5/8 inch diameter. Furnish with a hardened steel cup point set screw.
- B. MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1-1/2 inch diameter.

#### **2.05 CONCRETE INSERTS**

- A. Poured in Place:
  - 1. MSS SP-69 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity.
  - 2. MSS SP-69 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter.
- B. Drilled Fasteners:
  - 1. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

#### **2.06 CONTINUOUS CONCRETE INSERT CHANNELS**

- A. Steel inserts with an industry standard pre-galvanized finish, nominally 1-5/8 inch wide by 1-3/8 inch deep by length to suit the application, designed to be nailed to concrete forms and provide a linear slot for attaching other support devices. Installed channels to provide a load rating of 2000 pounds per foot in concrete. Manufacturer's standard brackets, inserts, and accessories designed to be used with the channel inserts may be used. Select insert length to accommodate all pipe in the area.

#### **2.07 ANCHORS**

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

#### **2.08 EQUIPMENT STANDS**

- A. Use structural steel members welded to and supported by pipe supports. Clean, prime and coat with three coat rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere coatings.

#### **2.09 CORROSIVE ATMOSPHERE COATINGS**

- A. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123, 1.5 ounces/square foot of surface each side. Mechanical galvanize threaded products, ASTM B695 Class 50, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.
- B. Corrosive atmospheres include the following locations:
  - 1. Chemical storage and hazardous waste storage rooms
  - 2. Food service/kitchen areas
  - 3. Walk-in coolers/freezers

### **PART 3 – EXECUTION**

#### **3.01 INSTALLATION**

- A. Size, apply and install supports and anchors in compliance with manufacturers recommendations.
- B. Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten

ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

- C. Coordinate hanger and support installation to properly group piping of all trades.
- D. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior approval.
- E. Size and install hangers and supports, except for riser clamps, for installation on the exterior of piping insulation. Where a vapor barrier is not required, hangers may be installed either on the exterior of pipe insulation or directly on piping.
- F. Perform welding in accordance with standards of the American Welding Society.

**3.02 HANGER AND SUPPORT SPACING**

- A. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- B. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
- C. Use hangers with 1-1/2 inch minimum vertical adjustment.
- D. Support riser piping independently of connected horizontal piping.
- E. Adjust hangers to obtain the slope specified in the piping section of these specifications.
- F. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Max. Horiz. Spacing	Max. Vert. Spacing
Cast Iron	2" and larger	5'-0"	15'-0"
Copper	1/2" through 3/4"	5'-0"	10'-0"
Copper	1" through 1 1/4"	6'-0"	10'-0"
Copper	1 1/2" through 2 1/2"	8'-0"	10'-0"
Copper	3"	10'-0"	10'-0"
Copper	4" and larger	12'-0"	10'-0"
Steel	1/2" through 1 1/4"	7'-0"	15'-0"
Steel	1 1/2" through 6"	10'-0"	15'-0"
Steel	8" through 12"	14'-0"	20'-0"
Steel	14" and larger	20'-0"	20'-0"
PVC (DWV)	1 1/2" and larger	4'-0"	10'-0"

**3.03 CONCRETE INSERTS AND CONTINUOUS INSERT CHANNELS**

- A. Select size based on the manufacturer's stated load capacity and weight of material that will be supported. Locate continuous insert channels on 6'-0" maximum centers and 2'-0" from corners. Furnish inserts to the General Contractor for placement in concrete formwork. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inch size. Where concrete slabs form finished ceiling, provide inserts that are flush with the slab surface.

**3.04 ANCHORS**

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

END OF SECTION

**SECTION 22 07 00  
PLUMBING INSULATION**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Unless noted otherwise, the Plumbing Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes insulation specifications for plumbing piping and equipment.
  - 1. Insulation
    - a. Rigid Fiberglass Insulation
    - b. Semi-Rigid Fiberglass Insulation
    - c. Calcium Silicate Insulation
    - d. Elastomeric Insulation
    - e. Polyolefin Insulation
    - f. Phenolic Insulation
    - g. Extruded Polystyrene Insulation
    - h. Urethane Insulation
    - i. Cellular Glass Insulation
    - j. Fireproofing Insulation
  - 2. Covers and Jackets
    - a. PVC Fitting Covers and Jackets
  - 3. Insulation Inserts And Pipe Shields
  - 4. Accessories

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 22 05 00 – Common Work Results for Plumbing
- C. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
- D. Section 22 13 00 – Facility Sanitary Sewerage
- E. Section 22 14 00 – Facility Storm Drainage
- F. Section 22 30 00 – Plumbing Equipment

**1.04 SUBMITTALS**

- A. Refer to Section 22 05 00 – Common Work Results for Plumbing, Submittals. In addition to the general content specified under Section 22 05 00 – Common Work Results for Plumbing, supply the following submittals:
  - 1. Insulation
    - a. Rigid Fiberglass Insulation
    - b. Semi-Rigid Fiberglass Insulation
    - c. Calcium Silicate Insulation
    - d. Elastomeric Insulation
    - e. Polyolefin Insulation
    - f. Phenolic Insulation
    - g. Extruded Polystyrene Insulation
    - h. Urethane Insulation
    - i. Cellular Glass Insulation
    - j. Fireproofing Insulation
  - 2. Covers and Jackets
    - a. PVC Fitting Covers and Jackets
  - 3. Insulation Inserts And Pipe Shields
  - 4. Accessories

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

#### **1.05 REFERENCE STANDARDS**

- A. ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate
- B. ASTM C165 Test Method for Compressive Properties of Thermal Insulations
- C. ASTM C177 Heat Flux and Thermal Transmission Properties
- D. ASTM C195 Mineral Fiber Thermal Insulation Cement
- E. ASTM C240 Cellular Glass Insulation Block
- F. ASTM C302 Density of Preformed Pipe Insulation
- G. ASTM C303 Density of Preformed Block Insulation
- H. ASTM C449 Mineral Fiber Hydraulic Setting Thermal Insulation Cement
- I. ASTM C518 Heat Flux and Thermal Transmission Properties
- J. ASTM C533 Calcium Silicate Block and Pipe Thermal Insulation
- K. ASTM C534 Preformed Flexible Elastomeric Thermal Insulation
- L. ASTM C547 Mineral Fiber Preformed Pipe Insulation
- M. ASTM C552 Cellular Glass Block and Pipe Thermal Insulation
- N. ASTM C553 Mineral Fiber Blanket and Felt Insulation
- O. ASTM C578 Preformed, Block Type Cellular Polystyrene Thermal Insulation
- P. ASTM C591 Preformed Rigid Cellular Polyurethane Thermal Insulation
- Q. ASTM C610 Expanded Perlite Block and Thermal Pipe Insulation
- R. ASTM C612 Mineral Fiber Block and Board Thermal Insulation
- S. ASTM C921 Properties of Jacketing Materials for Thermal Insulation
- T. ASTM C1136 Flexible Low Permeance Vapor Retarders for Thermal Insulation
- U. ASTM E84 Surface Burning Characteristics of Building Materials
- V. MICA National Commercial & Industrial Insulation Standards
- W. NFPA 225 Surface Burning Characteristics of Building Materials
- X. UL 723 Surface Burning Characteristics of Building Materials

#### **1.06 QUALITY ASSURANCE**

- A. Substitution of Materials: Refer to Division 1.
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.

#### **1.07 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified in Section 22 05 00 – Common Work Results for Plumbing.

#### **1.08 DESCRIPTION**

- A. Furnish and install all insulating materials and accessories as specified or as required for a complete installation. The following types of insulation are specified in this section:
  - 1. Pipe Insulation
  - 2. Equipment Insulation
- B. Install all insulation in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions. Exceptions to these standards will only be accepted where specifically modified in these specifications, or where prior written approval has been obtained from the Owner's Project Representative.

#### **1.09 DEFINITIONS**

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

## **PART 2 – PRODUCTS**

### **2.01 MATERIALS**

- A. Materials or accessories containing asbestos will not be accepted.
- B. Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:
  - 1. Insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke developed rating no higher than 150.

### **2.02 INSULATION AND JACKETS**

- A. Manufacturers: Armstrong, Certainteed Manson, Childers, Dow, Extol, Halstead, H.B. Fuller, Imcoa, Knauf, Owens-Corning, Pittsburgh Corning, Rubatex, Johns-Mansville, or approved equal.
- B. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.
- C. Rigid Fiberglass Insulation:
  - 1. Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.
  - 2. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.
- D. Semi-Rigid Fiberglass Insulation:
  - 1. Minimum nominal density of 3 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75 degrees F, minimum compressive strength of 125 PSF at 10% deformation, rated for service to 450 degrees F. Insulation fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.
  - 2. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.
- E. Calcium Silicate Insulation:
  - 1. Rigid hydrous calcium silicate, ASTM C533, Type I, minimum dry density of 12.5 lbs. per cu. ft., thermal conductivity of not more than 0.44 at 300 degrees F, maximum water absorption of 90% by volume, minimum compressive strength 140 psi at 5% deformation, rated for service range of 0 degrees F to 1,200 degrees F. Material to be visually coded or marked to indicate it is asbestos free.
- F. Elastomeric Insulation:
  - 1. 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 transmission 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.
- G. Polyolefin Insulation:
  - 1. 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.
- H. Phenolic Insulation:
  - 1. Rigid closed cell, minimum nominal density of 2.2 lbs. per cu. ft., thermal conductivity of not more than 0.13 at 75 degrees F, minimum compressive strength of 31 psi parallel and 18 psi perpendicular, maximum water vapor transmission 0.117 perm inch, maximum water absorption of .5% by volume, rated for service range of -290 degrees F to 250 degrees F.
  - 2. Kraft reinforced foil vapor barrier laminate all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.
- I. Extruded Polystyrene Insulation:
  - 1. 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.
- J. Urethane Insulation:
    1. Rigid closed cell polyisocyanurate, minimum nominal density of 1.8 lbs. per cu. ft., thermal conductivity of not more than 0.19 at 75 degrees F aged 180 days, minimum compressive strength of 19 psi parallel and 10 psi perpendicular, maximum water vapor transmission of 4 perm inch, maximum water absorption of .2% by volume, rated for service range of -290 degrees F to 300 degrees F.
  - K. Cellular Glass Insulation:
    1. Rigid closed cell, minimum nominal density of 8.5 lbs. per cu. ft., thermal conductivity of not more than 0.36 at 50 degrees F, minimum compressive strength of 100 psi, maximum water vapor transmission of 0.0 perm inch, maximum water absorption of .2% by volume, rated for service range of -450 degrees F to 900 degrees F.
  - L. Fireproofing Insulation:
    1. Mineral fiber with nominal density of 8 lbs. per cu. ft., flame spread index of 15, fuel contribution index of 0, and smoke developed index of 0, thermal conductivity of not more than 0.23 at 75 degrees F.
    2. Jacket material shall be the same as jacket for adjacent insulation.
  - M. PVC Fitting Covers and Jackets:
    1. White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be .02 inch (20 mil).

### **2.03 INSULATION INSERTS AND PIPE SHIELDS**

- A. Manufacturers: B-Line, Pipe Shields, Value Engineered Products
- B. Construct inserts with calcium silicate, 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 of 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.
- C. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered pre-manufactured product described above. On low temperature systems, extruded polystyrene may be substituted for calcium silicate provided insert and shield length and gauge are increased to compensate for lower insulation compressive strength.
- D. Precompressed 20# density molded fiberglass blocks, Hamfab, of same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1" x 6" block for piping through 2-1/2" and three 1" x 6" blocks for piping through 4". Submit shield schedule to demonstrate equivalency to pre-engineered/pre-manufactured product described above.
- E. Wood blocks will not be accepted.

### **2.04 ACCESSORIES**

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be .015 inch for aluminum and .010 inch for stainless steel.
- D. Tack fasteners to be stainless steel ring grooved shank tacks.
- E. Staples to be clinch style.
- F. Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.
- G. Finishing cement to be ASTM C449.
- H. Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.
- I. Bedding compounds to be non-shrinking and permanently flexible.
- J. Vapor barrier coatings to be non-flammable, fire resistant, polymeric resin.

- K. Fungicidal water base coating (Foster 40-20) to be compatible with vapor barrier coating.

### **PART 3 – EXECUTION**

#### **3.01 INSTALLATION**

- A. Install insulation, jackets and accessories in accordance with manufacturer's instructions and under ambient temperatures and conditions recommended by manufacturer. Surfaces to be insulated must be clean and dry.
- B. Do not insulate systems or equipment which are specified to be pressure tested or inspected, until testing, inspection and any necessary repairs have been successfully completed.
- C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Cover and seal exposed fiberglass insulation when insulation is terminated, no raw fiberglass insulation is allowed. Provide neat and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates. Install with longitudinal joints facing wall or ceiling.
- D. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.
- E. Use full-length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.
- F. Insulation shall be continuous through sleeves and openings. Vapor barriers shall be maintained continuous through all penetrations.
- G. Provide a complete vapor barrier for insulation on the following systems:
  - 1. Cold water (potable and non-potable)
  - 2. Storm Water

#### **3.02 PIPING, VALVE AND FITTING INSULATION**

- A. General:
  - 1. Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2" lap on jacket seams and 2" tape on butt joints, firmly cemented with lap adhesive. Additionally secure with staples along seams and butt joints. Coat staples with vapor barrier mastic on systems requiring vapor barrier.
  - 2. Water supply piping insulation shall be continuous throughout the building and installed adjacent to and within building walls to a point directly behind the fixture that is being supplied.
  - 3. Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation. Where a vapor barrier is not required, hangers and supports may be attached directly to piping with insulation completely covering hanger or support and jacket sealed at support rod penetration. Where riser clamps are required to be attached directly to piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.
- B. Insulation Inserts and Pipe Shields:
  - 1. Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.
- C. Fittings and Valves:
  - 1. Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation of the same thickness as adjoining insulation. Cover insulation with fabric reinforcing and mastic or where temperatures do not exceed 150 degrees, PVC fitting covers. Secure PVC fitting covers with tack fasteners and 1-1/2" band of mastic over ends, throat, seams or penetrations. On systems requiring vapor barrier, use vapor barrier mastic.
- D. Elastomeric:
  - 1. Where practical, slip insulation on piping during pipe installation when pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. Apply full bed of adhesive to both surfaces.
- E. Polyolefin:
  - 1. Where practical, slip insulation on piping during pipe installation when pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. For polyolefin, seal factory preglued seams with roller and field seams and joints with full bed of hot melt polyolefin glue to both surfaces.



- F. Protective Jackets:
1. Provide a protective PVC jacket for the following insulated piping: exposed in food handling areas, wet areas, and where below 7'-0" AFF where subject to physical contact.
  2. 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.

G. Pipe Insulation Schedule:

1. Provide insulation on new and existing remodeled piping as indicated in the following schedule:

Service	Insulation Types	Insulation Thickness by Pipe Size		
		1" and smaller	1-1/4" to 2"	2-1/2" to 4"
Hot Water Supply	Rigid Fiberglass	1"	1"	1.5"
Hot Water Return	Rigid Fiberglass	1"	1"	1.5"
Cold Water	Rigid Fiberglass	0.5"	0.5"	1"
Non-Potable Cold Water	Rigid Fiberglass*	0.5"	0.5"	1"
Non-Potable Hot Water	Rigid Fiberglass*	1"	1"	1.5"
All Storm Piping	Rigid Fiberglass	0.5"	0.5"	0.5"
Clearwater Waste	Rigid Fiberglass*	0.5"	0.5"	0.5"

\* Elastomeric & Phenolic types are acceptable

2. The following piping and fittings are not to be insulated:
  - a. Chrome plated exposed supplies and stops (except where specifically noted).
  - b. Water hammer arrestors.
  - c. Piping unions and flanges for systems not requiring a vapor barrier.

### 3.03 EQUIPMENT INSULATION

- A. Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.
- B. Semi-Rigid Fiberglass:
  1. 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.
- C. Elastomeric:
  1. 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.
- D. Polyolefin:
  1. 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.
- E. Equipment Insulation Schedule:

1. Provide equipment insulation as follows:

Equipment	Insulation Type	Thickness	Remarks
Water Meter	Elastomeric	1/2"	Sheet type, fabricated for ease of removal and replacement when service is required.
R.P.B.P.	Elastomeric	1/2"	Sheet type, pipe size type or combination of both. Fabricated for ease of removal and replacement when testing and servicing is required.

### 3.04 CONSTRUCTION VERIFICATION CHECKLISTS

- A. Contractor is responsible for completing construction verification checklists.

END OF SECTION

**SECTION 22 11 00  
FACILITY WATER DISTRIBUTION**

**PART 1 - GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Unless noted otherwise, the Plumbing Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section contains specifications for plumbing pipe and pipe fittings for this project.
  - 1. Domestic Water
  - 2. Dielectric Unions And Flanges
  - 3. Unions And Flanges
  - 4. Mechanical Grooved Pipe Connections
  - 5. Piping System Leak Tests

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 22 05 14 – Plumbing Specialties
- C. Section 22 05 15 – Piping Specialties
- D. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

**1.04 SUBMITTALS**

- A. Refer to Section 22 05 00 – Common Work Results for Plumbing, Submittals. In addition to the general content specified under Section 22 05 00 – Common Work Results for Plumbing, supply the following submittals:
  - 1. Domestic Water
  - 2. Dielectric Unions And Flanges
  - 3. Unions And Flanges
  - 4. Mechanical Grooved Pipe Connections
  - 5. Piping System Leak Tests
- B. Schedule from the contractor indicating the ASTM or AWWA specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.

**1.05 REFERENCE STANDARDS**

- A. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
- B. ASTM B32 Solder Metal
- C. ASTM B88 Seamless Copper Water Tube
- D. ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
- E. AWS A5.8 Brazing Filler Metal

**1.06 QUALITY ASSURANCE**

- A. Substitution of Materials: Refer to Division 1.
- B. Order all pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the owner.

**1.07 DESIGN CRITERIA**

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

- B. Construct all piping for the highest pressures and temperatures in the respective system.
- C. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

**1.08 DELIVERY, STORAGE AND HANDLING**

- A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

**PART 2 – PRODUCTS**

**2.01 DOMESTIC WATER**

- A. Above Ground:
  - 1. Type L copper water tube, H (drawn) temper, ASTM B88; wrought copper pressure fittings, ANSI B16.22; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP. Copper mechanical grooved fittings and couplings on roll grooved pipe may be used in lieu of soldered fittings. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for branch takeoffs up to one-half (1/2) the diameter of the main.

**2.02 DIELECTRIC UNIONS AND FLANGES**

- A. Manufacturers: Watts Regulator Company, Lochinvar, Wilkins or EPCO Sales, Inc.
- B. Dielectric unions 2" and smaller; dielectric flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets, having a pressure rating of not less than 175 psig at 180 degrees.

**2.03 UNIONS AND FLANGES**

- A. Unions, flanges and gasket materials to have a pressure rating of not less than 150 psig at 180 degrees. Gasket material for flanges and flanged fittings shall be Teflon type. Treated paper gaskets are not acceptable.
- B. 2" and Smaller Copper:
  - 1. ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.
- C. 2 ½" and Larger Copper:
  - 1. ANSI B15.24 Class 150 cast bronze flanges with full face Teflon gaskets.

**2.04 PRESS FITTING PIPE CONNECTIONS**

- A. Manufacturer: Viega, Victaulic, or approved manufacturer.
- B. All press fitting materials including o-rings, couplings, fittings and adapters shall be from the same manufacturer.
- C. Bronze press fittings for copper tubing shall conform to the material and sizing, requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM. Maximum operating pressure of 200 psi.

**2.05 MECHANICAL GROOVED PIPE CONNECTIONS**

- A. Manufacturers: Anvil, Grinnell, Star, Victaulic
- B. Mechanical grooved pipe couplings and fittings, ASTM F1476, may be used with cut groove galvanized steel pipe, cut groove ductile iron pipe or roll groove copper pipe where noted. Mechanical grooved components and assemblies to be rated for minimum 250 psi working pressure.

- C. All mechanical grooved pipe material including gaskets, couplings, fittings and flange adapters shall be from the same manufacturer.
- D. Couplings shall be malleable iron, ASTM A47, or ductile iron ASTM A536 with painted finish. Reducing couplings are not acceptable.
- E. Fittings used on copper pipe shall be copper.
- F. Gaskets shall be EPDM, ASTM D2000. Gaskets for hot water systems to be flush seal design. Heat treated carbon steel oval neck track bolts and nuts, ASTM A183, with zinc electroplated finish ASTM B633.
- G. Credit for the inherent flexibility of mechanical grooved pipe connections when used for expansion joints or flexible connectors may be allowed upon specific application by the Contractor. Three flexible couplings at first three connection points both upstream and downstream of pumps may be used in lieu of flexible connectors. Request for expansion joints shall be made in writing and shall include service, location, line size, proposed application and supporting calculations for the intended service.

### **PART 3 – EXECUTION**

#### **3.01 GENERAL**

- A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.

#### **3.02 PREPARATION**

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

#### **3.03 ERECTION**

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Maintain piping in clean condition internally during construction.
- D. Provide clearance for installation of insulation, access to valves and piping specialties.
- E. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- F. Do not route piping through transformer vaults or above transformers, panelboards or switchboards, including the required service space for this equipment.
- G. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

#### **3.04 COPPER PIPE JOINTS**

- A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

#### **3.05 THREADED PIPE JOINTS**

- A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

### **3.06 MECHANICAL GROOVED PIPE CONNECTIONS**

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

### **3.07 PRESS FITTING PIPE CONNECTIONS**

- A. Press fitting connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark of the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

### **3.08 MECHANICALLY FORMED TEE FITTINGS**

- A. Form mechanically extracted collars in a continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. Use an adjustable collaring device. Notch and dimple the branch tube. Braze the joint with neutral flame oxy-acetylene torch, applying heat properly so that pipe and tee do not distort; remove distorted connections.

### **3.09 DOMESTIC WATER**

- A. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.
- B. Install interior water piping with drain valves where indicated and at low points of system to allow complete drainage. Install shutoff valves where indicated and at the base of risers to allow isolation of portions of system for repair. Do not install water piping within exterior walls.
- C. Prior to use, isolate and fill system with potable water. Allow to stand 24 hours. Flush each outlet proceeding from the service entrance to the furthest outlet for minimum of 1 minute and until water appears clear. Fill system with a solution of water and chlorine containing at least 50 parts per million of chlorine and allow to stand for 24 hours. Alternately a solution containing at least 200 parts per million of chlorine may be used and allowed to stand for 3 hours. Flush system with potable water until chlorine concentration is no higher than source water level.
- D. Wait 24 hours after final flushing. Take samples of water for lab testing. The number and location of samples shall be representative of the system size and configuration and are subject to approval by Engineer. Test shall show the absence of coliform bacteria. If test fails, repeat disinfection and testing procedures until no coliform bacteria are detected. Submit test report indicating date and time of test along with test results.

### **3.10 DIELECTRIC UNIONS AND FLANGES**

- A. Install dielectric unions or flanges at each point where a copper-to-steel pipe connection is required in domestic water systems.

### **3.11 UNIONS AND FLANGES**

- A. Install a union or flange at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

### **3.12 PIPING SYSTEM LEAK TESTS**

- A. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
- B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.

- C. For hydrostatic tests, use clean water and remove all air from the piping being tested. Measure and record test pressure at the high point in the system.
- D. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test. Caulking will not be acceptable.
- E. Entire test must be witnessed by the Owner's representative. All pressure tests are to be documented on form included in specification.

<u>Test System</u>	<u>Medium</u>	<u>Initial Test</u>		<u>Final Test</u>	
		<u>Pressure</u>	<u>Duration</u>	<u>Pressure</u>	<u>Duration</u>
Above Ground Domestic Water	Water	N/A		100 psig	8 hr.
Above Ground Non-potable Water	Water	N/A		100 psig	8 hr.

**3.13 CONSTRUCTION VERIFICATION CHECKLISTS**

- A. Contractor is responsible for utilizing the construction verification checklists supplied under these specifications in accordance with the procedures defined for construction verification checklists.

END OF SECTION

# PIPING SYSTEM TEST REPORT

Date Submitted: \_\_\_\_\_

Project Name: \_\_\_\_\_

Location: \_\_\_\_\_ Project No: \_\_\_\_\_

Contractor: \_\_\_\_\_

Plumbing  Fire Sprinkler

Test Medium:  Air  Water  Other\_\_

Test performed per specification section No. \_\_\_\_\_

Specified Test Duration \_\_\_\_\_ Hours Specified Test Pressure \_\_\_\_\_ PSIG

System Identification: \_\_\_\_\_

Describe Location: \_\_\_\_\_

Test Date: _____	
Start Test Time: _____	Initial Pressure: _____ PSIG
Stop Test Time: _____	Final Pressure: _____ PSIG

Tested By: \_\_\_\_\_ Witnessed By: \_\_\_\_\_

Title: \_\_\_\_\_ Title: \_\_\_\_\_

Signed: \_\_\_\_\_ Signed: \_\_\_\_\_

Date: \_\_\_\_\_ Date: \_\_\_\_\_

Comments: \_\_\_\_\_

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**SECTION 22 13 00  
FACILITY SANITARY SEWERAGE**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Unless noted otherwise, the Plumbing Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section contains specifications for plumbing pipe and pipe fittings for this project.
  - 1. Sanitary Waste And Vent
  - 2. Piping System Leak Tests

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 22 05 14 – Plumbing Specialties
- C. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

**1.04 SUBMITTALS**

- A. Refer to Section 22 05 00 – Common Work Results for Plumbing, Submittals. In addition to the general content specified under Section 22 05 00 – Common Work Results for Plumbing, supply the following submittals:
  - 1. Sanitary Waste And Vent
  - 2. Piping System Leak Tests
- B. Schedule from the contractor indicating the ASTM or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.

**1.05 REFERENCE STANDARDS**

- A. ASTM A74 Cast Iron Soil Pipe and Fittings
- B. ASTM A888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- C. ASTM C564 Standard Specifications for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- D. ASTM C1540 Standard Specifications for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings
- E. ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe
- F. ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40
- G. ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
- H. ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
- I. ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- J. ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings
- K. ASTM D3311 Drain, Waste and Vent (DWV) Plastic Fitting Patterns
- L. ASTM F438 Socket Type Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40
- M. ASTM F441 Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80
- N. ASTM F493 Standard Specification for Solvent Cements for Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe and Fittings
- O. ASTM F656 Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
- P. CISPI 301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications
- Q. CISPI 310 Couplings For Use In Connection With Hubless Cast Iron Soil Pipe And Fittings For Sanitary And Storm Drain, Waste And Vent Piping Applications



## **1.06 QUALITY ASSURANCE**

- A. Substitution of Materials: Refer to Division 1.
- B. Order all pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the owner.

## **1.07 DESIGN CRITERIA**

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, or CISPI specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system.
- C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings.

## **1.08 DELIVERY, STORAGE AND HANDLING**

- A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

## **PART 2 – PRODUCTS**

### **2.01 SANITARY WASTE AND VENT**

- A. Interior Above Ground:
  - 1. Hubless cast iron soil pipe and fittings, ASTM A888; with heavy-duty shielded stainless steel no-hub couplings, CISPI 301, CISPI 310, ASTM A74, ANACO/Husky SD4000, Clamp-All Corp-125. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute or receive prior approval of the Engineer.
    - a. Manufacturers: A B & I Foundry, Charlotte Pipe and Foundry, Tyler Pipe
- B. Interior Below Ground:
  - 1. PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
  - 2. Greasy waste piping: Chlorinated Polyvinyl Chloride (CPVC), ASTM D1784, ASTM D2846, ASTM F441, with DWV fittings, schedule 40 listed and labeled for drain or pressure applications. Solvent cemented joints conforming to ASTM F493, and manufacturer's instructions. One step or two step primer and solvent cement as required by local code. Pipe is supported in accordance with the manufacturer's instructions. Pipe, valves, and fittings are by the same manufacturer, Spears Manufacturing Company, Charlotte FlowGuard Gold, Corzan IPS.
- C. Exterior Below Ground 15" and Smaller:
  - 1. PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
  - 2. Greasy waste piping: Chlorinated Polyvinyl Chloride (CPVC), ASTM D1784, ASTM D2846, ASTM F441, with DWV fittings, schedule 40 listed and labeled for drain or pressure applications. Solvent cemented joints conforming to ASTM F493, and manufacturer's instructions. One step or two step primer and solvent cement as required by local code. Pipe is supported in accordance with the manufacturer's instructions. Pipe, valves, and fittings are by the same manufacturer, Spears Manufacturing Company, Charlotte FlowGuard Gold, Corzan IPS.

## **PART 3 – EXECUTION**

### **3.01 GENERAL**

- A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.

### **3.02 PREPARATION**

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

### **3.03 ERECTION**

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Install underground warning tape 6"-12" below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.
- D. Maintain piping in clean condition internally during construction.
- E. Do not route piping through transformer vaults or above transformers, panelboards or switchboards, including the required service space for this equipment.
- F. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.
- G. Install heavy-duty transition coupling when joining no-hub cast iron and PVC pipe, ASTM C1460 with ASTM C564 gasket, Husky SD4200 PVCxCI.

### **3.04 SOLVENT WELDED PIPE JOINTS**

- A. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.
- B. Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2 the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4-5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set. Reference manufacturer's recommendations for initial set time before handling and for full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by the Owner's Project Representative.

### **3.05 MECHANICAL HUBLESS PIPE CONNECTIONS**

- A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturers recommended torque.

**3.06 SANITARY WASTE AND VENT**

- A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/4" per foot where possible and in no case less than 1/8" per foot for piping 3" and larger.
- B. Install exterior piping below predicted frost level and not less than 5' bury depth to top of pipe wherever possible. Where piping is located above predicted frost level, provide frost protection.
- C. Flush piping inlets (floor drains, hub drains, mop basins, fixtures, etc.) with high flow of water at completion of project to demonstrate full flow capacity. Remove blockages and make necessary repairs where flow is found to be impeded.

**3.07 PIPING SYSTEM LEAK TESTS**

- A. For hydrostatic tests, use clean water and remove all air from the piping being tested. Measure and record test pressure at the high point in the system.
- B. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.
- C. Entire test must be witnessed by the Owner's representative. All pressure tests are to be documented.

<u>System</u>	<u>Test Medium</u>	<u>Initial Test</u>		<u>Final Test</u>	
		<u>Pressure</u>	<u>Duration</u>	<u>Pressure</u>	<u>Duration</u>
Sanitary Waste and Vent	Water	N/A		10' water	2 hr.

**3.08 CONSTRUCTION VERIFICATION CHECKLISTS**

- A. Contractor is responsible for completing construction verification checklists.

END OF SECTION

**SECTION 22 14 00  
FACILITY STORM DRAINAGE**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Unless noted otherwise, the Plumbing Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section contains specifications for plumbing pipe and pipe fittings for this project.
  - 1. Storm
  - 2. Piping System Leak Tests

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 01 91 13 – Commissioning Requirements
- C. Section 22 05 14 – Plumbing Specialties
- D. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

**1.04 SUBMITTALS**

- A. Refer to Section 22 05 00 – Common Work Results for Plumbing, Submittals. In addition to the general content specified under Section 22 05 00 – Common Work Results for Plumbing, supply the following submittals:
  - 1. Storm
  - 2. Piping System Leak Tests
- B. Schedule from the contractor indicating the ASTM or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.

**1.05 REFERENCE STANDARDS**

- A. ASTM A74 Cast Iron Soil Pipe and Fittings
- B. ASTM A888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- C. ASTM C564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- D. ASTM C1540 Heavy Duty Shielded Couplings for Joining Hubless Cast Iron Soil Pipe and Fittings
- E. CISPI 301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications
- F. CISPI 310 Couplings For Use In Connection With Hubless Cast Iron Soil Pipe And Fittings For Sanitary And Storm Drain, Waste And Vent Piping Applications

**1.06 QUALITY ASSURANCE**

- A. Substitution of Materials: Refer to Division 1.
- B. Order all pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the owner.

**1.07 DESIGN CRITERIA**

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM or CISPI specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system.

### **1.08 DELIVERY, STORAGE AND HANDLING**

- A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

## **PART 2 – PRODUCTS**

### **2.01 STORM**

- A. Interior Above Ground:
  - 1. Hubless cast iron soil pipe and fittings, ASTM A888; with heavy-duty shielded stainless steel no-hub couplings, CISPI 301, CISPI 310, ASTM A74, ANACO/Husky SD4000, Clamp-All Corp-125. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute.
    - a. Manufacturers: A B & I Foundry, Charlotte Pipe and Foundry, Tyler Pipe
- B. Interior Below Ground 15" and Smaller:
  - 1. Hubless cast iron soil pipe and fittings, ASTM A888; with heavy-duty shielded stainless steel no-hub couplings, CISPI 301, CISPI 310, ASTM A74, ANACO/Husky SD4000, Clamp-All Corp-125. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute.
    - a. Manufacturers: A B & I Foundry, Charlotte Pipe and Foundry, Tyler Pipe
- C. Exterior Below Ground 15" and Smaller:
  - 1. Hubless cast iron soil pipe and fittings, ASTM A888; with heavy-duty shielded stainless steel no-hub couplings, CISPI 301, CISPI 310, ASTM A74, ANACO/Husky SD4000, Clamp-All Corp-125. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute.
    - a. Manufacturers: A B & I Foundry, Charlotte Pipe and Foundry, Tyler Pipe

## **PART 3 – EXECUTION**

### **3.01 GENERAL**

- A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.

### **3.02 PREPARATION**

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

### **3.03 ERECTION**

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Maintain piping in clean condition internally during construction.
- C. Provide clearance for installation of insulation, access to valves and piping specialties.
- D. Do not route piping through transformer vaults or above transformers, panelboards or switchboards, including the required service space for this equipment.

- E. Install heavy-duty transition coupling when joining no-hub cast iron and PVC pipe, ASTM C1460 with ASTM C564 gasket, Husky SD4200 PVCxCI.

**3.04 MECHANICAL HUBLESS PIPE CONNECTIONS**

- A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturer’s recommended torque.

**3.05 STORM**

- A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/8" per foot where possible and in no case less than 1/16" per foot for piping 3" and larger.
- B. Install exterior piping below predicted frost level and not less than 5' bury depth to top of pipe wherever possible. Where piping is located above predicted frost level, provide frost protection.

**3.06 PIPING SYSTEM LEAK TESTS**

- A. For hydrostatic tests, use clean water and remove all air from the piping being tested. Measure and record test pressure at the high point in the system.
- B. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test. Caulking will not be acceptable.
- C. Entire test must be witnessed by the owner’s representative. All pressure tests are to be documented.

<u>System</u>	<u>Test</u>	<u>Initial Test</u>	<u>Final Test</u>	
	<u>Medium</u>	<u>Pressure</u>	<u>Pressure</u>	<u>Duration</u>
Storm	Water	N/A	10' water	2 hr.

**3.07 CONSTRUCTION VERIFICATION CHECKLISTS**

- A. Contractor is responsible for completing construction verification checklists.

END OF SECTION

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**SECTION 22 30 00  
PLUMBING EQUIPMENT**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Unless noted otherwise, the Plumbing Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes specifications for water heaters, water softeners, pumps and other equipment used for plumbing applications.
  - 1. High Efficiency SS Commercial Gas Fired Water Heater
  - 2. Residential Electric Water Heater
  - 3. Water Softeners
  - 4. In-Line System Lubricated Centrifugal Pumps

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Section 22 05 13 - Common Motor Requirements for Plumbing
- C. Section 22 05 15 - Piping Specialties
- D. Section 22 05 23 - General-Duty Valves for Plumbing Piping
- E. Section 22 07 00 - Plumbing Insulation
- F. Division 26 - Electrical

**1.04 SUBMITTALS**

- A. Refer to Section 22 05 00 - Common Work Results for Plumbing, Submittals. In addition to the general content specified under Section 22 05 00 – Common Work Results for Plumbing, supply the following submittals:
  - 1. High Efficiency Stainless Steel Commercial Gas Fired Water Heater
  - 2. Residential Electric Water Heater
  - 3. Water Softeners
  - 4. In-Line System Lubricated Centrifugal Pumps
- B. Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, pump curves with net positive suction head requirements, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

**1.05 FUNCTIONAL TESTS**

- A. Refer to Section 22 05 00 – Common Work Results for Plumbing, Functional Tests. In addition to the general content specified under Section 22 05 00 – Common Work Results for Plumbing, supply the following functional tests:
  - 1. High Efficiency Stainless Steel Commercial Gas Fired Water Heater
  - 2. Residential Electric Water Heater
  - 3. Water Softeners
  - 4. In-Line System Lubricated Centrifugal Pumps

**1.06 QUALITY ASSURANCE**

- A. Substitution of Materials: Refer to Division 1.
- B. Plumbing products requiring approval by the State of Wisconsin Dept. of Safety & Professional Services must be approved or have pending approval at the time of shop drawing submission.

**1.07 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified under in Section 22 05 00 – Common Work Results for Plumbing.



## **PART 2 – PRODUCTS**

### **2.01 HIGH EFFICIENCY STAINLESS STEEL COMMERCIAL GAS FIRED WATER HEATER**

- A. Manufacturers: Heat Transfer Products, Rheem, Voyager.
- B. Type: Gas fired sealed combustion condensing commercial water heater, minimum 94% thermal efficiency. Design to be AGA certified with 3 year tank warranty and 1 year parts warranty.
- C. Tank: 316L stainless steel tank rated for 150 psig complete with submerged combustion chamber, 90/10 cupronickel heat exchanger, foam insulation, plastic jacket, brass drain valve and temperature and pressure relief valve.
- D. Burner: Side mounted power burner.
- E. Controls: 120 volt, 1 phase, 60 Hz self-diagnostic electronic controls, intermittent spark or hot surface ignition, operating thermostat with 70°-180° F adjustable temperature control, energy cutoff with manual reset, blower pressure switch, gas valve and pressure regulator.
- F. Vent: 3" CPVC or ABS flue gas outlet and PVC, CPVC or ABS combustion air intake with DWV solvent weld fittings.
- G. Condensate Drain: PVC with solvent weld fittings. Drain neutralizer package.

### **2.02 RESIDENTIAL ELECTRIC WATER HEATER**

- A. Manufacturers: A.O. Smith, American, Bradford White, Lochinvar, Rheem, Ruud, State.
- B. Type: Electric storage domestic water heater. Design to be UL listed with 3 year commercial use tank warranty and 1 year parts warranty.
- C. Efficiency:
  - 1. 20 gallons and <12 kW 0.94 Minimum Energy Factor
- D. Tank: Steel glass lined tank rated for 150 psig complete with removable magnesium anode rod, plastic diffuser type dip tube, inlet and outlet heat trap fittings, minimum R-20 polyurethane foam insulation, painted steel jacket, drain valve and temperature and pressure relief valve.
- E. Elements: Replaceable threaded, low or medium watt density, incoloy sheath with adjustable thermostat control, energy cutoff.

### **2.03 WATER SOFTENERS**

- A. Manufacturers: Amtrol, Capital, Culligan, Hellenbrand.
- B. Tanks: Fiberglass reinforced mineral tank constructed of molded high density polyethylene inner shell reinforced by exterior fiberglass winding and epoxy resin. NSF approved and rated for 150 psig. Mount slotted or lateral hub PVC distributor in tank with underbedding gravel.
- C. Mineral: High capacity ion exchange mineral, FDA approved, Sybron/Ionac, Rohm & Haas, Resintech or Puralite. Uniform beads rated for removal of 30,000 grains of hardness as calcium carbonate when regenerated with 15 lbs. of salt. Design for minimum 50% resin bed freeboard.
- D. Valve: Top mount brass valve with motor drive, hydraulically balanced piston, seal and spacers, adjustable brine flow control, backwash flow control, adjustable capacity and regeneration settings. Provide bypass ball valve arrangement.
- E. Controls: Factory wired and tested controls with transformer and labeled terminal block:
  - 1. Simplex system
  - 2. Electronic Meter and Microprocessor control with LED Display for Delayed Regeneration.
- F. Brine Tank: High density polyethylene brine tank with high salt platform, PVC brine measuring and float valve, PVC injector. Contractor to provide initial salt fill.
- G. Ratings: Maximum 10 MG/L hardness leakage, 110° F maximum operating temperature, 30-100 psig operating pressure, 120/60/1 electrical.
- H. Accessories:
  - 1. Flexible braided stainless steel pipe connectors.
  - 2. Inlet and outlet pressure gauges with shutoff valve.

### **2.04 IN-LINE SYSTEM LUBRICATED CENTRIFUGAL PUMPS**

- A. Manufacturer: Bell and Gossett, Grundfos, Taco.
- B. Type: Horizontal single stage close coupled system lubricated in-line pumps, 125 psig maximum working pressure at operating temperature of 225° F continuous, single speed. The manufacturer shall certify all pump ratings. All pumps to operate without excessive noise or vibration.

- C. Casing: Bronze or stainless steel; flanged suction and discharge connection.
- D. Impeller: Bronze, stainless steel or thermoplastic, keyed to the shaft, single suction enclosed type, hydraulically and dynamically balanced.
- E. Bearings: System lubricated carbon sleeve bearings.
- F. Shaft: Stainless steel or ceramic.
- G. Seal: Stainless steel can isolating rotor and stator.
- H. Motor: Provide pump with impedance protected motor sized for non-overloading over the entire pump curve. Furnish each pump and motor with a nameplate giving the manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current.
- I. Control: Combination automatic timer kit with aquastat combination, pump runs only when timer is ON and water temperature is low enough to cause the aquastat to switch ON.

### **PART 3 – EXECUTION**

#### **3.01 INSTALLATION**

- A. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- B. Set commercial water heaters, commercial water softeners, storage tanks and booster pumps on concrete housekeeping pads. Adjust and level equipment.
- C. Set sumps on compacted granular backfill adjusting for plumb and level. Backfill in even layers around sump with granular backfill.
- D. Connect equipment to water and drain piping using unions or flanges and isolation valves.
- E. Size temperature and relief valves per CSA ratings. Pipe temperature and pressure relief valves to floor drain or floor as indicated.
- F. Startup and test equipment adjusting operating and safety controls for proper operation.
- G. Cycle softeners and adjust for specified exchange rate, regeneration time, consumption, backflow rate, etc. Provide initial salt fill of brine tank.
- H. Lubricate pumps before startup. Adjust pumps for rated flow. Clean and blowdown strainers after 8 hours of operation.

#### **3.02 TRAINING**

- A. See Section 22 05 00 – Common Work Results for Plumbing for general training requirements.
- B. In addition to the training provided in Section 22 05 00 – Common Work Results for Plumbing, provide an additional 2 hours of training for each type of plumbing equipment provided on the project.

#### **3.03 CONSTRUCTION VERIFICATION CHECKLISTS**

- A. Contractor is responsible for completing construction verification checklists.

#### **3.04 FUNCTIONAL TESTS**

- A. Contractor is responsible for completing functional performance tests.

END OF SECTION

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**SECTION 22 42 00**  
**COMMERCIAL PLUMBING FIXTURES**

**PART 1 - GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Unless noted otherwise, the Plumbing Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes specifications for plumbing fixtures, faucets and trim.
  - 1. Plumbing Fixtures
    - a. Hose Bibbs
    - b. Lavatories
    - c. Mop Basins
    - d. Urinals
    - e. Wall Boxes
    - f. Wall Hydrants
    - g. Water Closets

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Section 22 05 14 – Plumbing Specialties
- C. Section 22 11 00 – Facility Water Distribution
- D. Section 22 13 00 – Facility Sanitary Sewerage

**1.04 SUBMITTALS**

- A. Refer to Section 22 05 00 – Common Work Results for Plumbing, Submittals. In addition to the general content specified under Section 22 05 00 – Common Work Results for Plumbing, supply the following submittals:
  - 1. Hose Bibbs
  - 2. Lavatories
  - 3. Mop Basins
  - 4. Urinals
  - 5. Wall Boxes
  - 6. Wall Hydrants
  - 7. Water Closets
- B. Include data concerning sizes, rough in-dimensions, capacities, materials of construction, trim, finishes, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

**1.05 REFERENCE STANDARDS**

- A. ANSI A112.6.1M Supports for Off-the-Floor Plumbing Fixtures for Public Use
- B. ANSI A112.18.1 Finished and Rough Brass Plumbing Fixture Fittings
- C. ANSI A112.19.1 Enameled Cast Iron Plumbing Fixtures
- D. ANSI A112.19.2M Vitreous China Plumbing Fixtures
- E. ANSI A112.19.5 Trim for Water Closet Bowls, Tanks and Urinals
- F. ASSE 1011 Hose Connection Vacuum Breakers
- G. ASSE 1016 Individual Thermostatic, Pressure Balancing, and Combination Pressure Balancing and Thermostatic Control Valves for Individual Fixture Fittings

**1.06 QUALITY ASSURANCE**

- A. Substitution of Materials: Refer to Division 1.
- B. Plumbing products requiring approval by the State of Wisconsin Dept. of Safety & Professional Services must be approved or have pending approval at the time of shop drawing submission.

## 1.07 ENERGY EFFICIENCY REQUIREMENTS

- A. Plumbing fixtures must meet the following maximum water usage requirements:
  - 1. Public Lavatory Faucets: flow of 0.5 gallons per minute, or 0.25 gallons per cycle
  - 2. Sink Faucets: flow of 2.2 gallons per minute
  - 3. Urinal Flush Valves: 1.0 gallons per flush
  - 4. Water Closet Flush Valves: 1.6 gallons per flush

## PART 2 – PRODUCTS

### 2.01 PLUMBING FIXTURES

- A. Manufacturers: Fixture descriptions establish fixture type, quality, materials, features and size. Products of the following manufacturers determined to be equal by the Architect/Engineer will be accepted. Architect to select from manufacturer's standard finish colors.
  - 1. Vitreous China and Enameled Cast Iron Fixtures: American Standard, Kohler, Sloan, Toto, Zurn
  - 2. Water Closet Seats: Bemis, Beneke, Centoco, Olsonite Sperzel
  - 3. Faucets: Chicago Faucet, American Standard, Sloan, Zurn
  - 4. Stops and Supplies: Chicago Faucet, McGuire, Zurn
  - 5. Flush Valves: Sloan, Zurn
  - 6. Drains and Traps: Kohler, McGuire, Dearborn, Zurn
  - 7. Carriers and Supports: Josam, J.R. Smith, Wade, Watts, Zurn
  - 8. Molded Stone Fixtures: Fiat, Mustee
  - 9. Hose Bibbs and Wall Hydrants: Chicago Faucet, Josam, J.R. Smith, Wade, Woodford, Zurn
  - 10. Thermostatic Mixing Valves: Bradley, Lawler, Leonard, Powers
  - 11. Wall Boxes: Guy Gray, Oatey, Sioux Chief
- B. Hose Bibbs:
  - 1. HB-1: Bronze or brass body hose faucet, 3/4" inlet, 3/4" outlet, with polished chrome finish, ASSE 1011 hose connection vacuum breaker and metal wheel handle.
    - a. Faucet: Woodford Model 24PC
- C. Lavatories:
  - 1. WF-1: ADA multi-station wall mounted wash fountain, 14 gauge 304 stainless steel bowl, semi-circular 38" diameter, individual sectional sprayhead control with vandal-resistant 0.5 gpm each nozzle, includes ASSE 1070 thermostatic mixing valve with integral checks and strainers. Unit includes four (4) stations, contoured base, off-floor mounting, push-button hand operation, with wash column braced to backsplash. Include drain valves at lowest point of supply roughing to facilitate winterizing. Set station/nozzle flow time for 15 seconds.
    - a. Fixture: Acorn 3424-ES-ADA-1-H-CB
    - b. Supplies: McGuire H2165LK
    - c. Trap: 1 1/2" x 1 1/2" 17 gauge cast brass p-trap
- D. Mop Basins:
  - 1. MB-1: Floor mounted precast terazzo mop basin, 24" x 24" x 12", with 3" drain, stainless steel strainer, stainless steel wall guard (two wall guards for corner installation), mop hanger, faucet with pail hook, wall brace, and ASSE 1011 hose connection vacuum breaker. Faucet with exposed supplies from above, include stops with check valves.
    - a. Fixture: Fiat TSB100
    - b. Wall Guards: Fiat MSG
    - c. Strainer: Fiat 1453BB
    - d. Faucet Exposed Supplies: Chicago Faucet 835-RCF
    - e. Vacuum Breaker: Watts 8A
    - f. Hose & Bracket: Fiat 832AA
- E. Urinals:
  - 1. UR-1: Accessible wall mounted white vitreous china 1.0 gallon per flush washout urinal with 3/4" top inlet spud, 2" outlet spud, removable strainer, manually operated 1.0 gpf flush valve. Mount rim maximum 17" above finished floor. Coordinate rim height with Architectural detail.
    - a. Fixture: Kohler Bardon K-4991-ET
    - b. Flush Valve: Sloan Royal 186-1

- c. Carrier: Zurn 1218 Series
- 2. UR-2: Identical to UR-1. Mounted fixture rim height of 24" above finished floor, or as directed by Architect.
- F. Wall Boxes:
  - 1. WB-1: Steel ice maker wall box, white powder coated finish, with faceplate frame, fire rated intumescent pad when installed in rated wall, 1/2" sweat inlet, and NSF 61 quarter turn ball valve. Include in-line water hammer arrester. Include ASSE 1022 dual check with atmospheric vent backflow preventer where connected equipment does not have Wisconsin DSPS approval.
    - a. Fixture: Guy Gray Model MIB1AB
    - b. Fixture: Guy Gray Model FRMIB12S
    - c. Water Hammer Arrester: Sioux Chief 660-GT
    - d. Backflow Preventer: Watts SD-3
- G. Wall Hydrants:
  - 1. WH-1: Freeze proof automatic draining wall hydrant, with chrome plated wall box and door, 3/4" inlet, 3/4" hose thread ASSE 1019-B hose connection vacuum breaker, and loose key operator.
    - a. Faucet: Woodford Model B65CH
- H. Water Closets:
  - 1. WC-1: Accessible wall hung white vitreous china high efficiency siphon jet water closet with elongated bowl, 1 1/2" top spud, 2 1/8" passageway and 1.6 gallon flush. Manually operated 1.6 gpf flush valve, lever mounted to wide side of stall. Extra Heavy Duty 750 lbs rated carrier. Open front seat with self-sustaining check hinge. Coordinate tail piece length with grab-bars. Mount fixture rim height of 16-1/2" above finished floor. Coordinate rim height with Architectural detail.
    - a. Fixture: Kohler Kingston K-4325
    - b. Flush Valve: Sloan Royal 113-1.6
    - c. Seat: Bemis 1655-SS/C white solid plastic with open front
    - d. Carrier: Zurn Z1201-XH Series
  - 2. WC-2: Identical to WC-1. Mounted fixture rim height of 15" above finished floor, or as directed by Architect.

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. Install plumbing fixtures in accordance with manufacturer's instructions. Set level and plumb. Secure in place to counters, floors and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall. Secure rough-in fixture piping to prevent movement of exposed piping.
- B. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.
- C. Install barrier free fixtures in compliance with the Wisconsin Building Code and Federal ADA Accessibility Guidelines. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to avoid contact by wheelchair users.
- D. Install wall mounted urinals as directed by Architect, or where not designated as follows:
  - 1. Where individual toilet rooms contain one or more wall mounted urinals, install at least one urinal with the lip not to exceed 17" above finished floor. Install all additional urinals within the same room with the lip 24" above finished floor.
- E. Install wall mounted water closets as directed by Architect, or where not designated as follows:
  - 1. WC-1 ADA accessible, fixture rim 16-1/2" above finished floor. Install flush valve with lever oriented towards wide side of room or stall.
  - 2. WC-2 Fixture rim 15" above finished floor.
- F. Each fixture shall have a stop valve installation to control the fixture. Stop valves shall be heavy duty type with brass stems and screwed or sweat inlet connections. Compression type inlets are not acceptable.
- G. Cover pipe wall penetrations with escutcheons. Exposed traps, stops, piping and escutcheons to be chrome plated brass, unless otherwise indicated.

- H. Set floor mounted plumbing fixtures, counter mounted sinks, lavatory and sink faucets and drains with full setting bed of flexible non-staining plumber's putty.
- I. Seal wall mounted plumbing fixtures to wall with silicone sealant. Seal mop basins to floor and wall with grout or silicone sealant.
- J. Seal openings between walls, floors and fixtures with mildew-resistant silicone sealant same color as fixture.
- K. Mount wall hydrants in exterior wall construction with valve extended beyond interior side of building insulation. Slope to drain to building exterior. Install 24" minimum above finished grade. Set wall hydrant in grout or caulk and fill exterior wall penetration with insulation.
- L. Adjust lavatory mixing valve outlet water temperature and shower valve temperature limit stops to maximum 105°F.
- M. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components. Adjust flush valves for intended water flow rate to fixtures without splashing, noise or overflow. Adjust self-closing faucets to 15 second cycle.
- N. Protect fixtures during construction. At completion clean plumbing fixtures and trim using manufacturer's recommended cleaning methods and materials.

END OF SECTION

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

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. It is the intent of these specifications to provide complete and workable mechanical systems as shown on the accompanying plans and as specified herein except such parts as are specifically exempted herein. Provide all necessary supervision, coordination, labor, materials, equipment, fixtures, dryage, hoisting, tools, transportation, plant services and facilities, machinery and connections to utilities for the installation of complete and operable mechanical systems. If details or special conditions are required in addition to those shown on drawings, provide all material and equipment usually furnished with such systems or required to complete their installation, whether noted in plans and specification or not.
- B. Materials and labor shall be new (unless noted otherwise), first class and workmanlike and shall be subject at all times to the A/E's inspections, tests and approval from the commencement until the acceptance of the completed work.
- C. The layout shown on the drawings is necessarily diagrammatic but shall be followed as closely as other work will permit. The drawings provide design intent. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.
- D. Because of the scale of the Drawings, certain basic items, such as, pipe fittings, duct fittings, access panels, and sleeves, may not be shown. Where such items are required by Code or by other Sections, or where required for proper installation of the Work, such items shall be included, whether shown or not.
- E. In the event of any inconsistencies between the specifications, drawings, contract documents, applicable laws, statutes, ordinances, building codes, rules and regulations, the contractor shall provide the better quality or greater quantity of work and comply with or conform its work to the most stringent legal or contractual requirements.
- F. Changes from these drawings required to make this work conform to the building construction shall be made only with prior written approval of the Architect/Engineer. All proposed changes shall be shown on shop drawings. All measurements shall be verified by actual observation and all work shall fit in place meeting the approval of the Architect/Engineer.
- G. Equipment Specification may not deal individually with minute items required, such as, components, parts, controls, and devices which may be required to produce the equipment performance specified or as required to meet the equipment warranties. Where such items are required to make the system operational, they shall be included by the supplier of the equipment at no additional cost, whether or not specifically called for.

**1.02 SECTION INCLUDES**

- A. This section includes information common to two or more technical specification sections or items that are of a general nature, not conveniently fitting into other technical sections.
  - 1. Submittals
  - 2. Reference Standards
  - 3. Quality Assurance
  - 4. Guarantee
  - 5. Work by Owner
  - 6. Equipment Furnished by Others
  - 7. Provisions for Future
  - 8. Operation and Maintenance Instructions
  - 9. Record Documents
  - 10. Continuity of Existing Services
  - 11. Protection of Finished Surfaces
  - 12. Sealing And Firestopping
  - 13. Off Site Storage
  - 14. Regulatory Requirements
  - 15. Certificates And Inspections

16. Coordination
17. Demolition And Existing Requirements
18. Request And Certification For Payment
19. Sleeves And Openings
20. Omissions
21. Definitions
22. Project/Site Conditions
23. Work Sequence And Scheduling
24. Salvage Materials
25. Training
26. Access Panels And Doors
27. Identification
28. Demolition
29. Excavation And Backfill
30. Concrete Work
31. Cutting And Patching
32. Lintels
33. Building Access
34. Equipment Access
35. Lubrication
36. Housekeeping And Clean Up

### **1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. This section applies to all Division 23 sections.
- C. Section 05 50 00 – Metal Fabrications
- D. Division 31 – Earthwork

### **1.04 SUBMITTALS**

- A. Submit shop drawings for equipment under each section per requirements listed in that section, as well as per Division 1.
- B. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission. Do not submit hard copies of web pages. Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project schedule.
- C. On request from the A/E, the successful bidder shall furnish additional drawings, illustrations, catalog data, performance characteristics, etc.
- D. Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.
- E. The submittals must be approved before fabrication is authorized.
- F. Provide electronic copies of all submittals for review.
- G. Before submitting electrically powered equipment, verify that the electrical power and control requirements for the equipment are in agreement with the motor starter schedule on the electrical drawings. Include a statement on the shop drawing transmittal to the architect/engineer that the equipment submitted and the motor starter schedule are in agreement or indicate any discrepancies. See related comments in Section 23 05 13 in Part 1 under Electrical Coordination.

### **1.05 REFERENCE STANDARDS**

- A. Abbreviations of standards organizations referenced in other sections are as follows:
  1. AABC Associated Air Balance Council
  2. ADC Air Diffusion Council
  3. AGA American Gas Association

4.	AMCA	Air Movement and Control Association
5.	ANSI	American National Standards Institute
6.	AHRI	Air-Conditioning, Heating and Refrigeration Institute
7.	ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
8.	ASME	American Society of Mechanical Engineers
9.	ASTM	American Society for Testing and Materials
10.	AWWA	American Water Works Association
11.	AWS	American Welding Society
12.	CGA	Compressed Gas Association
13.	EJMA	Expansion Joint Manufacturers Association
14.	EPA	Environmental Protection Agency
15.	ETL	Edison Testing Laboratories
16.	FM	Factory Mutual Insurance Company
17.	GAMA	Gas Appliance Manufacturers Association
18.	HI	Hydraulic Institute
19.	ICC	International Code Council
20.	IEEE	Institute of Electrical and Electronics Engineers
21.	IRI	Industrial Risk Insurers
22.	ISA	Instrument Society of America
23.	ISO	International Organization for Standardization
24.	MCAA	Mechanical Contractors Association of America
25.	MICA	Midwest Insulation Contractors Association
26.	MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
27.	NBS	National Bureau of Standards
28.	NEBB	National Environmental Balancing Bureau
29.	NEC	National Electric Code
30.	NEMA	National Electrical Manufacturers Association
31.	NFPA	National Fire Protection Association
32.	OSHA	Occupational Safety and Health Administration
33.	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association. Inc.
34.	TABB	Testing, Adjusting and Balancing Bureau
35.	UL	Underwriters Laboratories Inc.
36.	ASTM E814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops
37.	ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
38.	UL1479	Fire Tests of Through-Penetration Firestops
39.	UL723	Surface Burning Characteristics of Building Materials

#### **1.06 QUALITY ASSURANCE**

- A. Substitution of Materials: Refer to Division 1 for equals and substitutions.
1. Where the following conflicts with Division 1, the requirements of Division 1 shall govern.
  2. If the Contractor wishes to submit an alternate to the named manufacturers for any equipment, he may submit a voluntary alternative minimum 7 days prior to bid, stating the manufacturer's name, model number, written, detailed product data.
  3. Where materials or equipment are specified by name the proposed material or equipment must be identical to the specified material or equipment in all characteristics of quality, function and serviceability, regardless of application in the Project and, in addition, when the Architect deems that aesthetic significance is important, the equal material or equipment must be identical in all characteristics of visual appearance, design, color and texture. Any proposed equal shall be submitted to Architect/Engineer for prior approval, which Architect/Engineer may approve or disapprove in its sole discretion. Work performed or constructed with unapproved equals is at Contractor's risk and any required correction of work incorporating unapproved equals shall be at Contractor's sole cost and expense.
  4. In all instances, Contractor shall assume full responsibility for proof of equality of the statute to the equipment hereinafter specified. All data and information necessary for proof of equality, function and space requirements shall be prepared and accompany the submittal of the substitution

- to the Architect/Engineer. Approval by the Architect/Engineer of equipment other than the specified does NOT relieve Contractor of this responsibility.
- B. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.
  - C. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment/electrical or accessories into the system, including but not limited to, coordination with other trades and any required changes by other trades and for obtaining the performance from the system into which these items are placed. This may include changes found necessary during the testing, adjusting, and balancing phase of the project.

#### **1.07 GUARANTEE**

- A. Refer to Division 1 for Guarantees and Warranties. In addition to the requirements in Division 1, this Contractor shall meet the following requirements.
- B. In entering into a contract covering this work, the contractor accepts the specifications and guarantees that the work will be carried out in accordance with the requirements of this specification or such modifications as may be made under the contract documents.
- C. Contractor further guarantees that the workmanship and material will be of the best procurable and that none but experienced workmen familiar with each particular class of work will be employed.
- D. Contractor further guarantees to replace and make good at his own expense, including travel time, all defects, which may develop within 1 year after final payment and acceptance by the Architect/Engineer, due to faulty workmanship or material, upon, receipt of written notification from the Owner.

#### **1.08 WORK BY OWNER**

- A. None.

#### **1.09 EQUIPMENT FURNISHED BY OTHERS**

- A. Refer to Food Service Equipment Plans.

#### **1.10 PROVISIONS FOR FUTURE**

- A. Refer to Drawings.

#### **1.11 OPERATION AND MAINTENANCE INSTRUCTIONS**

- A. Refer to Division 1 for all operations and maintenance instructions.
- B. In addition to the general content specified under Division 1 supply the following additional documentation:
  - 1. Copies of all approved shop drawings along with approval letters.
  - 2. Manufacturer's wiring diagrams for electrically powered equipment
  - 3. Records of tests performed to certify compliance with system requirements
  - 4. Certificates of inspection by regulatory agencies
  - 5. Temperature control record drawings and control sequences
  - 6. Parts lists for manufactured equipment
  - 7. Valve schedules
  - 8. Lubrication instructions, including list/frequency of lubrication done during construction
  - 9. Warranties
  - 10. Additional information as indicated in the technical specification sections

#### **1.12 RECORD DOCUMENTS**

- A. Refer to Division 1 for record documents.
- B. In addition to the general content specified under Division 1, follow the following procedures.
  - 1. During the progress of the work, Contractor shall maintain a current (daily) record set of the drawings and specifications, indicating thereon all work installed at variance with such Contract Documents including, without limitation, work covered by Addenda, Field Work Orders, Change Orders and Engineers additional instructions, interpretations and clarification. All changes or deviations from the original layout of the work and all critical dimensions of buried or concealed

work shall be recorded. It shall be Contractor's responsibility to assure that said record sets are complete, accurate and up-to-date, Engineer shall have the right to inspect and review such record sets.

2. At the completion of the work, Contractor shall indicate on record sets all record changes and such additional details necessary or appropriate to provide a complete reference document for use by Engineer. If variations and details cannot be shown clearly thereon, the Contractor shall prepare supplemental drawings adequate to impart the information. The foregoing drawings collectively shall constitute the "Record" drawings for the work.
  3. All indication on "Record" drawings shall be executed in a legible manner at Contractor's cost, using methods and legend presentations compatible with the overall scheme of the record drawings with respect to scale, drawing sheet sizes and sequential indexing. All changes shall be marked clearly in red and clouded.
  4. Engineer may review Contractor's "Record" drawings and notify Contractor of observed discrepancies or deviations. Contractor shall promptly correct discrepancies, deviations or illegible markups at Contractor's expense and resubmit revised drawings for Engineer review.
- C. In addition to the data indicated in the Division 1, maintain temperature control record drawings on originals prepared by the installing contractor/subcontractor. Include copies of these record drawings with the Operating and Maintenance manuals.

#### **1.13 CONTINUITY OF EXISTING SERVICES**

- A. Do not interrupt or change existing services without prior written approval from the Owner's Project Representative. When interruption is required, coordinate scheduling of down-time with the Owner to minimize disruption to his activities. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.
- B. Each Contractor shall thoroughly familiarize himself with existing systems which will affect and be affected by relocation of existing equipment and installation of new lines and equipment. They shall plan installation of their work so that interruptions of services to any building or portion thereof will be a minimum and such interruptions shall occur only when system is not required, if possible. If not possible, each Contractor shall insure the operation of services by whatever means possible, such as, installing bypasses, capping of services or providing temporary service. Each interruption shall be for as short a duration as possible.
- C. No extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours.
- D. This Contractor shall restore any circuit interruption as a result of this work to proper operation as soon as possible. Note that institutional operations are on a seven day week schedule.

#### **1.14 PROTECTION OF FINISHED SURFACES**

- A. Refer to Division 1 for protection of finished surfaces.
- B. Furnish one aerosol spray can of touch-up paint for each different color factory finish which is to be the final finished surface of the product. Deliver touch-up paint with other "loose and detachable parts" per Division 1.

#### **1.15 SEALING AND FIRESTOPPING**

- A. Sealing, fireproofing patching, fire caulking and firestopping of sleeves/openings between ductwork, piping, etc. and the sleeve, structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.
- B. Contractor shall request current life safety drawings from Architect/Owner.

#### **1.16 OFF SITE STORAGE**

- A. Prior approval by Owner's personnel for offsite storage will be needed. No material will be accepted for offsite storage unless submittals for the material have been approved.

### **1.17 REGULATORY REQUIREMENTS**

- A. Comply with requirements of Wisconsin Administrative Code and local Authority Having Jurisdiction (AHJ) regarding materials and installation.

### **1.18 CERTIFICATES AND INSPECTIONS**

- A. Refer to Division 1 for permits, regulations, utilities and taxes.
- B. Obtain and pay for all required State or local installation inspections except those provided by the Architect/Engineer in accordance with State Code. Deliver originals of these certificates to the Owner. Include copies of the certificates in the Operating and Maintenance Instructions.
- C. Coordinate and provide inspections as required by the Authority Having Jurisdiction over the site.
- D. Where applications are required for procuring services to the Building, prepare and file such application with the utility company. Furnish all information required in connection with the application in the form required by the utility company.

### **1.19 COORDINATION**

- A. Refer to Division 1 for coordination. In addition to the requirements specified under Division 1, the following requirements apply.
- B. It shall be the responsibility of each Contractor to coordinate and consult with each other to determine space requirements and to determine that adequate space for servicing is provided for all equipment whether furnished by the Contractor or others. The General Contractor shall have final decision on all space priority conflicts among Contractors. All space priority conflicts shall be brought to the attention of the Architect/Engineer and Owner's Representative.
- C. Each Contractor shall thoroughly familiarize themselves with existing systems which will affect and be affected by relocation of existing equipment and installation of new lines and equipment. They shall plan installation of their work so that interruptions of services to any building or portion thereof will be a minimum, and such interruptions shall occur only when system is not required, if possible. If not possible, each Contractor shall insure the operation of services by whatever means possible, such as, installing bypasses, capping of services, or providing temporary service. Each interruption shall be for as short a duration as possible.
- D. Cooperation among all Contractors shall be required. Any Work that is installed without cooperating or coordinating with other Contractors and is in conflict shall be removed and reinstalled at that particular Contractor's cost. No cost additions to the Project will be considered due to a Contractor's lack of participation in the cooperation and coordination process. The following list of items of Work shall be the priority of order for all Contractors:
  - 1. Structure
  - 2. Recessed light fixtures
  - 3. Gravity-flow systems for sanitary, storm, steam and steam condensate piping
  - 4. Ductwork and appurtenances
  - 5. Electrical and low voltage cable tray
  - 6. Plumbing vent piping
  - 7. Fire protection (sprinkler system)
  - 8. HVAC piping
  - 9. Gas piping, process piping and domestic water
  - 10. Electrical conduit and low voltage conduit
  - 11. Control air lines or conduit
- E. The above list, in descending order, is the precedence assigned the Work items for space priority. Gravity-flow systems have first priority.
- F. Exception: Plumbing lines below or behind plumbing fixtures shall have precedence over all other work. Electrical conduit above or below switchgear, panelboards and control panels shall have precedence over all other work. Do not install any fluid conveying piping over electrical or elevator equipment.
- G. In the case of interconnection of the work of two or more contractors, verify at the site or on shop drawings all dimensions relating to such work. All errors due to the failure to so verify any such dimensions shall be promptly rectified.
- H. Any installed work that is not coordinated and interferes with another contractor's work shall be removed or relocated at the installing contractor's expense.

- I. Prior to start of Construction, the General Contractor shall schedule a meeting with all of the Contractors responsible for the work items listed above. The purpose of the meeting is to introduce the coordination program and to determine its implementation in relation to the progress schedule.
- J. At the initial Coordination Meeting, the Mechanical Contractor / Ventilating Contractor shall provide to the General Contractor outline drawings at 1/4" scale indicating column centerlines, interior partition locations, and ceiling heights. The General Contractor shall verify all information shown on these drawings and relay any changes in the information to the Ventilation Contractor to be reflected on the Drawings. The Ventilating Contractor, with reference and consideration to the Structural, Heating, Electrical, Fire Protection, and Plumbing Drawings, shall draw to scale his proposed installation showing duct sizes, equipment layouts, and dimensions from column lines and from finished floors to bottom of ducts. Ductwork shall be maintained as tightly as possible to the underside of floor slabs and/or beams. For congested areas the Ventilating Contractor shall, in addition, prepare Drawings in section view. During this phase of the program, it shall be the Electrical Contractor's responsibility to furnish the Ventilating Contractor with recessed lighting installation and clearance requirements. This information shall be outlined on the Drawings by the Ventilating Contractor.
- K. The ductwork layouts shall be produced in sequence as mandated by the Project Schedule. The earliest area indicated in the Schedule shall receive the first effort, etc.
- L. When the Ductwork Drawings for the earliest scheduled area have been completed (time limitation as determined at the initial coordination meeting), the Ventilating Contractor shall provide the General Contractor with one set of drawings for each participant in the effort. The General Contractor will distribute the drawings to the participating Contractors for their use in drawing thereon the major components of their proposed installation using the general scheme shown on the Contract Drawings as a guide.
- M. The major components to be indicated include (but are not limited to) the following:
  - 1. Structure
  - 2. Roof drain leaders
  - 3. Above 3" waste piping
  - 4. Sprinkler mains
  - 5. Conveying systems
  - 6. Significant conduit runs
  - 7. Cable trays
  - 8. Contract ceiling heights
  - 9. Soffits
  - 10. Access points
  - 11. Fire wall penetrations
  - 12. Gas, water, and process piping
- N. Information delineated shall be distance from column centerlines, pipe/equipment size, and distance from finished floor to bottom of pipe/equipment and hangers. Included on the Drawings shall be piping layout with hanger locations and hanger point loads. This information shall be developed satisfactorily enough to allow the Structural Engineer to verify the adequacy of the structural system for the projected loads. The hanger locations may have to be moved depending on the structural system review. No hanger shall be fabricated and/or installed until the hanger locations are reviewed and accepted by the Architect/Engineer.
- O. Within a period not to exceed two weeks after distribution of the drawings, the General Contractor will schedule a meeting with the Architect/Engineer and participating Contractors at which time areas of conflict shall be resolved. The drawings shall be overlaid to identify areas of conflict. All parties shall then cooperate in resolving the conflicts. Records of the agreements shall be entered on the Ventilating Contractor's drawings, acknowledged by all participants by signature in space provided for this purpose, and two copies distributed to all involved parties. All coordination drawing preparation and reproduction costs shall be borne by the Ventilating Contractor. The above drawings, review, and coordination process shall be repeated until all areas on the Project have been coordinated.
- P. In the event a Contractor fails to cooperate in the Coordination Program, they shall be held responsible for all costs incurred for adjustments to the work of others made necessary to accommodate the uncooperative Contractor's installations.

#### **1.20 DEMOLITION AND EXISTING REQUIREMENTS**

- A. Existing active services: water, gas, ventilation, sanitary waste, sanitary vent, storm electric, and any other building systems when encountered shall be protected against damage. Where existing services are to be abandoned, the services shall be removed back to the point of origin and removed from the site unless otherwise directed by the Owner's Representative.
- B. Submit a "Sequence of Work Schedule" in respect to all temporary and permanent utility and service cutovers after final determination. This schedule shall be submitted for approval to the Owner and Architect/Engineer. The submittal shall designate priority order, service or utility affected, date of cutover, and time of day to start and finish.
- C. Bidders should inspect the site to become familiar with conditions of the site which will affect the Work. Bidders should verify points of connection with utilities, routing of outside piping to include required clearances from any existing structures, or other obstacles.
- D. Extra payment will not be allowed for changes in the Work required because of the successful bidder's failure to make this inspection.

#### **1.21 REQUEST AND CERTIFICATION FOR PAYMENT**

- A. Within 10 days after Notice to Proceed, the successful bidder will submit to the Owner's Project Representative in a form prescribed by Division 1, a cost breakdown of the proposed values for work performed which, if approved by the owner, will become the basis for construction progress and monthly payments. The cost breakdown items shall reflect actual work progress stages as closely as feasible.
- B. In addition, if payment is requested for approved off-site stored material, then that material shall be listed as a line item in the request and certification for payment cost breakdown.

#### **1.22 SLEEVES AND OPENINGS**

- A. Openings required in new or existing construction that may be necessary for the installation of new work shall be provided by the respective contractor and all patching and repairing shall be done by workmen competent in the trade required, at the expense of the respective contractor. The respective contractor shall be responsible for arranging the work so that minimum cutting will be required. All rubbish and excess materials involved in such cutting shall be promptly removed from the site and disposed of by the contractor. Cutting through the floor or roof systems or load bearing walls shall be done only with the prior written approval of the Architect/Engineer so as to avoid damaging the structural system.

#### **1.23 OMISSIONS**

- A. No later than ten (10) days before bid opening, the Contractor shall call the attention of the A/E to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

#### **1.24 DEFINITIONS**

- A. The term "provide" includes such labor, methods, materials, equipment and transportation or other facilities required to complete the Contract and the performance of all duties thereby upon the Contractor.

#### **1.25 PROJECT/SITE CONDITIONS**

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of A/E before proceeding.
- C. Tools, materials and equipment shall be confined to areas designated by the Owner's project representative.

#### **1.26 WORK SEQUENCE AND SCHEDULING**

- A. Install work in phases to accommodate Owner's occupancy requirements. During the construction period coordinate schedule and operations with Owner's Construction Representatives.



### **1.27 SALVAGE MATERIALS**

- A. No materials removed from this project shall be reused (except as specifically noted below). All materials removed shall become the property of and shall be disposed of by the Contractor.

### **1.28 TRAINING**

- A. The contractor shall have the following responsibilities:
  - 1. Provide a training plan sixty days before the planned training covering the following elements:
    - a. Equipment
    - b. Intended audience
    - c. Location of training
    - d. Objectives
    - e. Subjects covered (description, duration of discussion, special methods, etc.)
    - f. Duration of training on each subject
    - g. Instructor for each subject
    - h. Methods (classroom lecture, manufacturer's quality video, site walk-through, actual operational demonstrations, written handouts, etc.).
  - 2. Provide designated owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment that makes up the system.
  - 3. Training shall normally start with classroom sessions followed by hands-on demonstration/training on each piece of equipment.
  - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system shall be repaired or adjusted as necessary and the demonstration repeated at another scheduled time, if necessary.
  - 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
  - 6. The controls contractor shall attend sessions other than the controls training, as specified, to discuss the interaction of the controls system as it relates to the equipment being discussed.
  - 7. The training sessions shall follow the outline in the table of contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
  - 8. Training shall include:
    - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
    - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include startup, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
    - c. Discussion of relevant health and safety issues and concerns.
    - d. Discussion of warranties and guarantees.
    - e. Common troubleshooting problems and solutions.
    - f. Explanatory information included in the O&M manuals.
    - g. Discussion of any peculiarities of equipment installation or operation.
    - h. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.
    - i. Hands-on training shall include startup, operation in all modes possible, including manual, shut-down, alarms, power failure and any emergency procedures, and preventative maintenance for all pieces of equipment.
  - 9. The contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls not controlled by the central control system.
- B. Video recording of the training sessions will be provided by the contractor and added to the O&M manuals. In addition, factory training videos identifying key troubleshooting, repair, service and/or replacement techniques shall be provided and reviewed with the owner.
- C. Provide a minimum of 8 hours of instruction.
- D. Provide additional training as specified in other specification sections for specific equipment.

## **PART 2 - PRODUCTS**

### **2.01 ACCESS PANELS AND DOORS**

- A. Lay-In Ceilings:
  - 1. Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Division 9 are sufficient; no additional access provisions are required unless specifically indicated.
- B. Plaster Walls And Ceilings:
  - 1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" by 12".

### **2.02 IDENTIFICATION**

- A. Piping and ductwork labels shall follow owner's labeling and naming standards.
- B. Stencils:
  - 1. Not less than 1 inch high letters/numbers for marking pipe and equipment.
- C. Snap-On Pipe Markers:
  - 1. Cylindrical self-coiling plastic sheet that snaps over piping insulation and is held tightly in place without the use of adhesive, tape or straps. Not less than 1 inch high letters/numbers and flow direction arrows for piping marking. W. H. Brady, Seton, Marking Services.
- D. Engraved Name Plates:
  - 1. White letters on a black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting, Setonply Style 2060 by Seton Name Plate Company or Emedolite- Style EIP by EMED Co., or equal by Marking Services, or W. H. Brady.
- E. Valve Tags:
  - 1. Round brass tags with 1/2 inch numbers, 1/4 inch system identification abbreviation, 1-1/4 inch minimum diameter, with brass jack chains or brass "S" hooks around the valve stem, available from EMED Co., Seton Name Plate Company, Marking Services, or W. H. Brady.

### **2.03 SLEEVES AND OPENINGS**

- A. General:
  - 1. Pipe sleeves shall be constructed of standard weight ASTM A53 or ASME B36.10 steel with an anchor plate constructed of A36/A36M steel welded to the pipe. The sleeve shall be sized a minimum of 1" larger than piping insulation diameter. The entire assembly shall be hot-dip galvanized after fabrication.
  - 2. Duct sleeves and piping sleeves passing through interior walls shall be constructed of 24 gauge galvanized steel minimum thickness.

### **2.04 SEALING AND FIRESTOPPING**

- A. Fire And/Or Smoke Rated Penetrations:
  - 1. Manufacturers: 3M, Hilti, Rectorseal, STI/SpecSeal, Tremco.
  - 2. All firestopping systems shall be provided by the same manufacturer.
  - 3. Submittals: Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.
  - 4. Product:
    - a. Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by the Owner and the Authority Having Jurisdiction (AHJ).
    - b. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
    - c. Contractor shall use firestop putty, caulk sealant, intumescent wrap strips, intumescent firestop collars, firestop blocks, firestop mortar or a combination of these products to provide

- a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.
  - d. All sealants shall meet the intent of LEED® VOC requirements, <250 g/L VOC contents (less H<sub>2</sub>O and exempt solvents).
- B. Non-Rated Penetrations:
- 1. Pipe Penetrations: At pipe penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster or wood partitions where sleeve is not required use urethane caulk in annular space between pipe insulation and wall material.
  - 2. Duct Penetrations:
    - a. Annular space between duct (with or without insulation) and the non-rated partition or floor opening shall not be larger than 2". Where existing openings have an annular space larger than 2", the space shall be patched to match existing construction to within 2" around the duct.
    - b. Where shown or specified, pack annular space with fiberglass batt insulation or mineral wool insulation. Provide 4" sheet metal escutcheon around duct on both sides of partition or floor to cover annular space.

### **PART 3 – EXECUTION**

#### **3.01 DEMOLITION**

- A. Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to be performed adjacent to existing work that remains in an occupied area, construct temporary dust partition to minimize the amount of contamination of the occupied space. Where pipe or duct is removed and not reconnected with new work, cap ends of existing services as if they were new work. Coordinate work with the owner to minimize disruption to the existing building occupants.
- B. All pipe, wiring and associated conduit, insulation, ductwork, and similar items demolished, abandoned, or deactivated are to be removed from the site by the Contractor. All piping and ductwork specialties are to be removed from the site by the Contractor unless they are dismantled and removed or stored by the owner. All designated equipment is to be turned over to the owner for their use at a place and time so designated. Maintain the condition of material and/or equipment that is indicated to be reused equal to that existing before work began.
- C. All contractors requiring the personnel/ material hoist and or temporary construction elevator (i.e. new elevators, temporarily protected) at times other than outlined in the temporary facilities specifications will make arrangements directly with the general contractor. The general contractor is responsible for all coordination and scheduling of the use of any hoisting equipment so the flow of the project is smoothly maintained and all workers have access to the work areas to perform their work and deliver material to the areas needed according to the project schedule.
- D. If any contractor's work requires the removal and replacement of any finished materials including but not limited to such materials as ceiling tiles, wall finishes, cabinets, doors, flooring, windows, etc. after those items are installed, each contractor will be responsible, at no additional cost to the owner, to replace any damaged, soiled or lost materials with new materials to match the existing materials and those materials damaged.

#### **3.02 EXCAVATION AND BACKFILL**

- A. Perform all excavation and backfill work to accomplish indicated mechanical systems installation in accordance with Division 31. Blasting will not be allowed without written permission of the Architect/Engineer and the owner.
- B. Install lines passing under foundations with minimum of 1-1/2 inch clearance to concrete and insure there is no disturbance of bearing soil.

#### **3.03 CONCRETE WORK**

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

### **3.04 CUTTING AND PATCHING**

- A. Refer to Division 1 for cutting and patching. In addition to the requirements in Division 1:
- B. Each Contractor shall coordinate the placing of openings in the new structure as required for the installation of each Contractor's work.
- C. Each Contractor shall furnish to the General Contractor the accurate locations and sizes for required openings in the new work, but this shall not relieve each Contractor of the responsibility of checking to assure that properly sized openings are provided. When additional patching is required due to the Contractor's failure to inspect this work, then the Contractor shall make arrangements for the patching required to properly close the openings to include patch painting, and the Contractor shall pay any additional cost incurred in this respect.
- D. If cutting and patching of the new structure is made necessary due to the Contractor's failure to install piping, ducts, sleeves, or equipment on schedule, or due to the Contractor's failure to furnish on schedule the information required for the leaving of openings, then it shall be the Contractor's responsibility to make arrangements and obtain approval from the General Contractor and Architect/Engineer for this cutting and patching, and the Contractor shall pay any additional cost incurred in this respect. The Contractor shall also reimburse the Owner for any additional costs incurred to the Architect/Engineer for additional services caused by the Contractor in this respect.
- E. The Contractor shall provide cutting and patching and patch painting in the existing structure as required for the installation of his Work and shall furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Architect/Engineer. Extent of cutting shall be minimized; use core drills, power saws, or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

### **3.05 LINTELS**

- A. All steel lintels required for opening in existing and/or new masonry walls shall be provided under section 05 50 00 – Metal Fabrications. This contractor shall design, fabricate, and install all lintels required in masonry walls for duct and pipe penetrations. Contractor shall submit design drawings of lintels with professional engineers seal and signature prior to installation.

### **3.06 BUILDING ACCESS**

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

### **3.07 EQUIPMENT ACCESS**

- A. Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance and service. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Access doors in general construction are to be furnished by the Mechanical Contractor and installed by the General Contractor.
- B. Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not require access panels.

### **3.08 COORDINATION**

- A. Verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to, diffusers, register, grilles, and recessed or semi-recessed heating and/or cooling terminal units installed in/on architectural surfaces.
- B. Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
- C. Cooperate with the test and balance agency in ensuring compliance with Section 23 05 93 – Testing, Adjusting and Balancing for HVAC. Verify system completion to the test and balance agency (flushing, pressure testing, chemical treatment, filling of liquid systems, proper pressurization and air venting of hydronic systems, clean filters, clean strainers, duct and pipe systems cleaned, controls adjusted and calibrated, controls cycled through their sequences, etc.), ready for testing, adjusting and

balancing work. Install dampers, shutoff and balancing valves, flow measuring devices, gauges, temperature controls, etc., required for functional and balanced systems. Demonstrate the starting, interlocking and control features of each system so the test and balance agency can perform its work.

### **3.09 IDENTIFICATION**

- A. Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of black enamel against a light background or white enamel against a dark background. Use a primer where necessary for proper paint adhesion. Do not label equipment such as cabinet heaters and ceiling fans in occupied spaces.
- B. Where stenciling is not appropriate for equipment identification, engraved name plates may be used.
- C. Identify piping not less than once every 30 feet, not less than once in each room, adjacent to each access door or panel, and on both side of the partition where exposed piping passes through walls, floors or roofs. Place flow directional arrows at each pipe identification location. Piping and ductwork labels shall follow owner's labeling and naming standards. Use one coat of black enamel against a light background or white enamel against a dark background for stenciling, or provide snap-on pipe markers as specified in Part 2 – Products.
- D. Identify valves with brass tags bearing a system identification and a valve sequence number. Valve tags are not required at a terminal device unless the valves are greater than ten feet from the device or located in another room not visible from the terminal unit. Provide a typewritten valve schedule indicating the valve number and the equipment or areas supplied by each valve; locate schedules in each mechanical room and in each Operating and Maintenance manual. Schedules in mechanical rooms to be framed under clear plastic.
- E. Use engraved name plates to identify control equipment.
- F. Label fire, smoke and combination fire smoke dampers on the exterior surface of ductwork directly adjacent to access doors using a minimum of 0.5 inch height lettering reading, "SMOKE DAMPER" or "FIRE DAMPER". Smoke and combination fire smoke dampers shall also include a second line listing the individual damper tag. The tags must be coordinated with the mechanical schedules. Utilize stencils or manufactured labels. All other forms of identification are unacceptable. All labels shall be clearly visible from the ceiling access point.

### **3.10 LUBRICATION**

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

### **3.11 SLEEVES AND OPENINGS**

- A. General:
  - 1. Sleeves are not required for piping and ducts passing through interior non-rated drywall, plaster, or wood partitions and interior poured concrete walls that have been saw cut or core drilled.
  - 2. Pack annular space between sleeves and pipe or ducts with fiberglass insulation and seal.
  - 3. Piping sleeves that pass through fire rated floors, walls, or ceilings shall be provided with a UL listed fire stop material meeting UL 1479 to seal the opening between the pipe and the pipe sleeve to maintain the fire rating.
  - 4. Provide escutcheon plates on piping to cover sleeve and insulation in finished areas.
  - 5. Refer to Division 1 for additional information on sleeves and openings.
- B. Sleeves Through Floors/Ceilings:
  - 1. Sleeves shall be installed to extend 1 inch above finished floor with a watertight sealant between floor and sleeve in all mechanical rooms and wet rooms listed below.
  - 2. If a sleeve is not provided, provide 1-1/2 inch angle ring with urethane caulk between the angle and the floor and seal at the corners to form a watertight seal.
    - a. Wet Locations:
      - 1) Mechanical Rooms
      - 2) Food service/kitchen areas (behind/under equipment, cabinets, tables, etc.)

### **3.12 SEALING AND FIRESTOPPING**

- A. The Contractor shall refer to building life safety drawings for all smoke and fire rates in addition to the mechanical drawings. Any discrepancies shall be brought to the attention of the Architect/Engineer before final addendum.
- B. Fire And/Or Smoke Rated Penetrations:
  - 1. Install approved product in accordance with the manufacturer's instructions where pipes penetrate a fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the insulation and vapor barrier.
  - 2. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any substantial weight.
- C. Non-Rated Partitions:
  - 1. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe and tighten in place, in accordance with manufacturer's instructions.
  - 2. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.
  - 3. Duct penetrations through non-rated partitions shall require sheet metal escutcheons with fiberglass or mineral wool insulation fill for spaces that include laboratories, clean rooms, animal rooms, kitchens, cart wash rooms, janitor closets, toilet rooms, mechanical rooms, conference rooms, private consultation rooms, and where noted on drawings elsewhere.

### **3.13 HOUSEKEEPING AND CLEAN UP**

- A. The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

END OF SECTION

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

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Provide premium efficiency motors for air handling units and fans as specified herein and shown on the drawings.

**1.02 SECTION INCLUDES**

- A. Section includes general requirements for single-phase and poly-phase general purpose squirrel-cage induction motors for use on AC powers systems up to 600 Volts. Included are the following sections:
  - 1. Single Phase Motors
  - 2. Polyphase Motors
  - 3. Motors with Multi-Speed Controllers

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 23 34 00 – HVAC Fans
- C. Section 23 55 00 – Fuel-Fired Heaters
- D. Section 23 82 00 – Heating and Cooling Terminal Units

**1.04 REFERENCE STANDARDS**

- A. The following Standards are referenced herein. Utilize the current edition of the referenced Standards unless otherwise noted:
  - 1. ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators.
  - 2. ANSI/IEEE 841 Standard for Petroleum and Chemical Industry-Premium-Efficiency, Severe-Duty, Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors-Up to and Including 500 hp.
  - 3. ANSI/NEMA MG-1 Motors and Generators
  - 4. ANSI/NFPA 70 National Electric Code

**1.05 COORDINATION**

- A. Coordinate features of motors, installed units and accessory devices to be compatible with:
  - 1. Motor controllers.
  - 2. Torque, speed and horsepower requirements of the load.
  - 3. Rating and characteristics of the supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of the installation location.
- B. All starters, overload relay heater coils, disconnect switches, fuses, relays, power wiring, power wiring conduit, push buttons, pilot lights and other devices for the control of motors or electrical equipment are furnished and installed by the Division 26 Contractor unless otherwise noted elsewhere in this Division of Specifications.

**PART 2 – PRODUCTS**

**2.01 GENERAL MOTOR REQUIREMENTS**

- A. Comply with the requirements of this Section unless stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with ANSI/NEMA MG-1 requirements unless otherwise noted.
- C. Comply with ANSI/IEEE 841 requirements for all severe-duty motors unless otherwise noted.

**2.02 MOTOR CHARACTERISTICS**

- A. Motors shall be continuous duty at ambient temperature of 40°C and an altitude of 3,300 feet above sea level.

- B. Capacity and torque characteristics shall be suitable to start, accelerate and operate the connected loads at the designated speeds, as the installed altitude and environment with the indicated operating sequence without exceeding the nameplate ratings or considering the service factor of the motor.
- C. Perform dynamic balancing and test motors after manufacture. Self-excited vibration velocity of motors shall not exceed limits set forth in NEMA MG-1, Part 7.
- D. Motors shall be standard, off the shelf, readily available for replacement. Special or customize motors will not be acceptable unless pre-bid approved.

### **2.03 SINGLE PHASE MOTORS**

- A. Motors 1/20 horsepower and smaller shall be shaded-pole type.
- B. Motors larger than 1/20 horsepower through 1/3 horsepower shall be one of the following to suit the starting torque and other requirements of the specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Capacitor start, capacitor run.
- C. Multi-speed motors shall be variable torque, permanent-split capacitor type.
- D. Bearings shall be pre-lubricated, anti-friction ball bearing or sleeve bearing type suitable for radial and thrust loading.
- E. Thermal protection shall be internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to the temperature rating of the motor insulation. Thermal-protection device shall automatically reset when the motor temperature returns to a normal range.

### **2.04 POLYPHASE MOTORS**

- A. Motors ½ horsepower and larger shall be NEMA MG-1, Design B medium induction polyphase motors unless otherwise noted. Motors shall random wound squirrel cage copper bar rotors.
- B. Motors shall be 200 volt motors unless otherwise noted.
- C. Motors shall be premium efficiency, meeting the requirements of NEMA MG-1.
- D. Motors shall be 4-pole (nominal 1800 rpm) unless otherwise noted.
- E. Service factor of motor shall be 1.15 unless otherwise noted.
- F. Motors windings and leads shall be copper.
- G. Motor insulation shall be Class F unless otherwise noted. Motor temperature rise shall match the motor insulation.
- H. Motors smaller than 15 horsepower shall utilize the manufacturer's starting characteristics.
- I. Motor enclosures shall be open drip-proof unless totally enclosed fan-cooled, total enclosed non-ventilated, explosion-proof or encapsulated motors are specified in other Sections.
- J. Motor enclosures for motor frame sizes 324T and larger shall be cast iron.
- K. Motor enclosures for motor frame sizes smaller than 324T shall be rolled steel or cast iron.
- L. Bearings shall be regreasable, shielded, anti-friction ball bearing type suitable for radial and thrust loading. Bearings shall be rated for a minimum ABMA 9, L10 life of 80,000 hours. Stamp the bearing sizes on the motor nameplate.
- M. Bearings on motors serving belt driven equipment shall utilize a bearing load calculated with NEMA minimum v-belt pulley with centerline at the end of the NEMA standard shaft extension.

### **2.05 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS**

- A. Motors used with Multi-Speed Controllers:
  - 1. Variable torque multi-speed motors shall be consequent-pole, single winding for motors with 2:1 speed ratio.
  - 2. Variable torque multi-speed motors shall be separate winding for motors with a speed ratio other than 2:1.
  - 3. Match the wiring connection requirements for the controller with the required motor leads.
  - 4. Provide terminals in motor terminal box suited to the control method.
  - 5. Furnish motors compatible with reduced voltage starting on the following equipment:



## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. Mount motors on a rigid base designed to accept a motor, using metal shims as required under each mounting foot to obtain a secure installation.
- B. Inspect and align each motor when direct coupled to the driven device. Alignment shall be within HVAC equipment manufacturer's limits.
- C. Perform dynamic balancing and test motors for vibration after manufacture. Self-excited vibration velocity of motors shall not exceed 0.157/0.06 inches per second at bearing caps.
- D. Inspect and align each motor when flexible coupled to the driven device. Use a dial indicator to check angular misalignment of the two shafts. Adjust the motor position as required so that the angular misalignment of the shafts does not exceed 0.002" per inch diameter of the coupling hub or the HVAC equipment manufacturer's limits, whichever is more stringent. Use a dial indicator to check the shaft for run-out to assure concentricity of the shafts. Adjust as required so that run-out does not exceed 0.002" per inch diameter of the coupling hub or the HVAC equipment manufacturer's limits, whichever is more stringent.
- E. Inspect and align each motor when connected to the driven device by means of a belt drive. Mount motor sheaves on the appropriate shafts as recommended by the equipment and motor manufacturers. Use a straight edge to check alignment of the sheaves. Reposition the sheaves as required to obtain the proper alignment. After the sheaves are aligned, adjust the motor base as required so that the belt(s) can be added and then tighten the motor base so that the belt tension is in accordance with the drive manufacturers recommendations. Frequently check the belt tension during the first 24 hours of operation and again after 80 hours of operation for proper belt tension. Adjust belt tension as required.

### **3.02 START-UP**

- A. Test start each motor to verify proper rotation prior to operating system.
- B. Lubricate all motors as recommended by motor manufacturer. Record lubrication material used and frequency of use. Include this lubrication log in the Operation and Maintenance manuals.

END OF SECTION

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

**PART 1 - GENERAL**

**1.01 SCOPE OF WORK**

- A. Unless noted otherwise, Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes valve specifications for all HVAC systems except where indicated under Related Work. Included are the following topics:
  - 1. Natural Gas Systems
    - a. Shut-off Valves (Gas)
    - b. Gas Pressure Regulators (Gas)

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 23 05 00 – Common Work Results for HVAC

**1.04 SUBMITTALS**

- A. Refer to Section 23 05 00 – Common Work Results for HVAC. In addition to the general content specified under Section 23 05 00 – Common Work Results for HVAC, supply the following submittals:
  - 1. Natural Gas Systems
    - a. Shut-off Valves (Gas)
    - b. Gas Pressure Regulators (Gas)
- B. Contractors shall submit a schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves to be used on the project. Temperature ratings specified are for continuous operation
- C. Contractors shall submit critical flow capacity data supplied by the manufacturer for all steam pressure reducing valves. The calculation from the manufacturer shall be the largest obtainable by internal trim change of the reducing valve.

**1.05 QUALITY ASSURANCE**

- A. Refer to Division 1 for equals and substitutions.

**1.06 DESIGN CRITERIA**

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

**1.07 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified in Section 23 05 00 – Common Work Results for HVAC.

**PART 2 – PRODUCTS**

**2.01 MANUFACTURERS**

- A. Anvil, Apollo, Armstrong, Bell & Gossett, Cash-Acme, Dresser Consolidated, Conval, Crane, Anderson Greenwood and Crosby, Danfoss-Flomatic, DeZurik, Durco, Fisher, Grinnell, Griswold, Hammond, Hancock, Hoffman, Jamesbury, Keystone, Kunkle, Leslie, Lunkenheimer/Cincinnati, Metraflex, Milwaukee, Mueller, Newco, Nexus, Nibco, Powell, RP&C, Sarco, Spence, Stockham, Taco, Tasco, Thrush-Amtrol, Vogt, Watts.

- B. All valves shall be designed for operation with not less than 125 lbs. working pressure and of a type permitting repacking while under pressure. Rising stems shall be used wherever possible. Provide valves to allow control of all major branches. All valves 2 inches and larger installed 7 feet on centerline or higher above the floor shall have chain operators.

## **2.02 NATURAL GAS SYSTEMS**

### **A. SHUT OFF VALVES:**

1. 2" and smaller: Ball valve, bronze body, threaded ends, chrome-plated bronze or stainless steel ball, full or conventional port, teflon seat, blowout-proof stem, two-piece construction, suitable for 150 psig working pressure, U.L. listed for use as natural gas 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 use as natural gas shut-off.
3. 5" and larger: Cast iron body, flanged ends, stainless steel bearings, resilient faced plugs, totally enclosed hand wheel actuators, 175 psi W.O.G., U.L. listed for use as natural gas shut-off.
4. DeZurik, Homestead, Rockwell, Walworth.

### **B. GAS PRESSURE REGULATORS:**

1. 2" and smaller: Cast iron body, aluminum spring and diaphragm, Nitrile diaphragm, threaded ends, 150 psi W.O.G., -20°F to 150°F.

## **PART 3 – EXECUTION**

### **3.01 GENERAL**

- A. Properly align piping before installation of valves in an upright position; operators installed below the valves will not be accepted.
- B. Install valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends.
- C. Install all temperature control valves.
- D. Install all valves with the stem in the upright position. Valves may be installed with the stem in the horizontal position only where space limitations do not allow installation in an upright position or where large valves are provided with chain wheel operators. Where valves 2-1/2" and larger are located more than 12'-0" above mechanical room floors, install valve with stem in the horizontal position and provide a chain wheel operator. Valves installed with the stems down, will not be accepted.
- E. Install stem extensions when shipped loose from valve.
- F. Prior to flushing of piping systems, place all valves in the full-open position.

### **3.02 SHUT-OFF VALVES**

- A. Install shut-off valves on both sides of all equipment, on major piping loops, at each branch take-off from mains, at vertical risers, at strainers, and at each automatic valve for isolation or repair. All shut-off valves shall be located to allow proper access for operation for servicing.

### **3.03 GAS PRESSURE REGULATORS**

- A. When the gas pressure regulator is equipped with a vent connection, run a connection size vent to the exterior of the building in accordance with codes. Use a larger size vent when required by the manufacturer's installation instructions.

END OF SECTION

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

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. The Contractor shall provide all labor and materials for the hangers and supports for heating equipment and pipe to have a complete system in this specification section. The Contractor shall provide all labor and materials for the hangers and supports for ventilating equipment and ductwork to have a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes specifications for supports of all HVAC equipment and materials as well as piping system anchors. Included are the following topics:
  - 1. Pipe Hanger and Support Manufacturers
  - 2. Structural Supports
  - 3. Pipe Hangers and Supports
  - 4. Wood Structure Supports
  - 5. Beam Clamps
  - 6. Concrete Inserts
  - 7. Anchors
  - 8. Equipment Curbs
  - 9. Pipe Penetrations through Roof
  - 10. Corrosive Atmosphere Coatings

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Section 23 05 00 – Common Work Results for HVAC
- C. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
- D. Section 23 07 00 – HVAC Insulation

**1.04 SUBMITTALS**

- A. Refer to Section 23 05 00 – Common Work Results for HVAC, Submittals. In addition to the general content specified under Section 23 05 00 – Common Work Results for HVAC, supply the following submittals:
  - 1. Pipe Hanger and Support Manufacturers
  - 2. Structural Supports
  - 3. Pipe Hangers and Supports
  - 4. Wood Structure Supports
  - 5. Beam Clamps
  - 6. Concrete Inserts
  - 7. Anchors
  - 8. Equipment Curbs
  - 9. Pipe Penetrations through Roof
  - 10. Corrosive Atmosphere Coatings
- B. Schedule of all hanger and support devices indicating shields, attachment methods, and type of device for each pipe size and type of service.
- C. All submittals are to comply with submission and content requirements specified in this specification.

**1.05 REFERENCE STANDARDS**

- A. MSS SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture.
- B. MSS SP-69 Pipe Hangers and Supports - Selection and Application.

**1.06 QUALITY ASSURANCE**

- A. Refer to Division 1 for equals and substitutions.

### **1.07 DESIGN CRITERIA**

- A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless noted otherwise.
- B. Piping connected to base mounted pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3 support distance.
- C. Piping flexible connections and vibration isolation supports are required for piping connected to coils that are in a fan assembly where the entire assembly is mounted on vibration supports; the vibration isolation supports are required for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Piping flexible connection and vibration isolation supports are not required when the fan section is separately and independently isolated by means of vibration supports and duct flexible connections. Standard pipe hangers/supports as specified in this section are required when there are no vibration isolation devices in the piping and beyond the 100 pipe diameter/3 support distance.
- D. Piping supported by laying on the bottom chord of joists or trusses will not be accepted.
- E. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.
- F. Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine maintenance, etc.

### **1.08 DESCRIPTION**

- A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for pressure piping.
- B. Do not hang any mechanical item directly from a metal deck or run piping so it rests on the bottom chord of any truss or joist.
- C. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.
- D. Protect insulation at all hanger points; see Related Work above.

## **PART 2 – PRODUCTS**

### **2.01 PIPE HANGER AND SUPPORT MANUFACTURERS**

- A. Anvil, B-Line, Fee and Mason, Kindorf, Michigan Hanger, Unistrut. Anvil figure numbers are listed below; equivalent material by other manufacturers is acceptable.

### **2.02 STRUCTURAL SUPPORTS**

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

### **2.03 PIPE HANGERS AND SUPPORTS**

- A. HANGERS FOR STEEL PIPE SIZES 1/2" THROUGH 2":
  - 1. Carbon steel, adjustable, clevis, black finish. Anvil figure 65 or 260.
- B. HANGERS FOR STEEL PIPE SIZES 2-1/2" AND OVER:
  - 1. Carbon steel, adjustable, clevis, black finish. Anvil figure 260.
  - 2. Adjustable steel yoke, cast iron roll, double hanger. Anvil figure 181.
- C. MULTIPLE OR TRAPEZE HANGERS:
  - 1. Steel channels with welded spacers and hanger rods if calculations are submitted.
- D. WALL SUPPORT:
  - 1. Welded steel bracket with hanger. B-Line 3068 Series, Anvil 194 Series.
  - 2. Perforated epoxy painted finish, 16-12 gauge min., steel channels securely anchored to wall structure with interlocking, split type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series clamps, Anvil type AS200 H with AS 1200 clamps. When copper

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

- E. VERTICAL RISER SUPPORT:
  - 1. Carbon steel riser clamp, copper plated when used with copper pipe. Anvil figure 261 for steel pipe, figure CT121 for copper pipe.
- F. FLOOR SUPPORT FOR PIPE SIZES THROUGH 4":
  - 1. Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
- G. COPPER PIPE SUPPORT:
  - 1. Carbon steel ring, adjustable, copper plated or polyvinylchloride coated.
- H. INSULATION PROTECTION SHIELDS:
  - 1. Galvanized carbon steel of not less than 18 gauge for use on insulated pipe 2-1/2 inch and larger. Minimum shield length is 12 inches. Equal to Anvil figure 167.
- I. STEEL HANGER RODS:
  - 1. Threaded both ends, threaded one end, or continuous threaded, black finish.
  - 2. Size rods for individual hangers and trapeze support as indicated in the following schedule.
  - 3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

Maximum Load (Lbs.) (650°F Maximum Temp.)	Rod Diameter (inches)
610	3/8
1130	1/2

Provide rods complete with adjusting and lock nuts.

**2.04 WOOD STRUCTURE SUPPORTS**

- A. Carbon steel pipe short strap for piping 1/2" through 2". Fastened with two No. 24 x 2 (minimum size) wood screws. Anvil Figure 262.
- B. Carbon steel coach screw rods machine threaded on opposite ends, minimum 3/8" diameter. Anvil Figure 142.
- C. Carbon steel side beam bracket with minimum 3/8" rod size and fastened with minimum 1/2" x 3" lag screws. Anvil Figure 207

**2.05 BEAM CLAMPS**

- A. MSS SP-69 Type 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick for single threaded rods of 3/8, 1/2, and 5/8 inch diameter, for use with pipe sizes 4 inch and less. Furnish with a hardened steel cup point set screw. Anvil figure 86.
- B. MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1-1/2 inch diameter but limited in application to pipe sizes 8 inch and less without prior approval. Anvil figure 228.

**2.06 CONCRETE INSERTS**

- A. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Approved manufacturers: Hilti, Rawl, Redhead.

**2.07 ANCHORS**

- A. Use welding steel shapes, plates, and bars to secure piping to the structure.9

**2.08 EQUIPMENT CURBS**

- A. Prefabricated Metal Curb:
  - 1. Constructed of not less than 18 gauge galvanized steel reinforced so it is structurally capable of supporting the intended load with no penetrations through the curb flashing, inside and outside corner sections that are mitered and continuously welded, filled with 3 pound density rigid fiberglass insulation, integral deck mounting flange, nominal two inch wood nailer, galvanized steel counter flashing. Do not use built-in metal base flashings or cants. Use 18 inch high

equipment curbs where the curb completely surrounds the perimeter of the equipment and there is no roof exposed to the weather.

**2.09 PIPE PENETRATIONS THROUGH ROOF**

- A. Multiple Pipe Penetrations:
  - 1. Refer to acceptable Equipment Curb types listed above for curb specifications. An 8” high (minimum) curb height is required. The coping cap shall be constructed from laminated acrylic clad thermoplastic (ABS) with graduated step boots to accommodate various size pipes, stainless steel fastening screws for cover, stainless steel band clamps for securing boots around the pipe, and stainless steel band clamp or mechanical locking seal for securing boots around the ABS coping cap flanges.
- B. Single Pipe Penetrations:
  - 1. A stack flashing penetration may be utilized for single pipe penetrations through built up roofs and single ply membrane roofs. Utilize high temperature sealant for all high temperature applications. This includes but is not limited to steam condensate vent piping, steam safety relief piping, and flues.
  - 2. A single pre-manufactured boot may be utilized for single pipe penetrations through single ply membrane roofs only.

**2.10 CORROSIVE ATMOSPHERE COATINGS**

- A. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123, 1.5 ounces/square foot of surface, each side. Mechanical galvanize threaded products, ASTM B695 Class 150, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.
- B. Corrosive atmospheres include the following locations:
  - 1. Exterior locations
  - 2. Food service/kitchen areas
  - 3. Walk-in coolers/freezers
  - 4. Locker/shower rooms

**PART 3 – EXECUTION**

**3.01 INSTALLATION**

- A. Install supports to provide for free expansion of the piping and duct system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- B. Piping shall be supported independently from ductwork and all other trades.
- C. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes for the supporting steel.
- D. Perform all welding in accordance with standards of the American Welding Society. Clean surfaces of loose scale, rust, paint or other foreign matter and properly align before welding. Use wire brush on welds after welding. Welds shall show uniform section, smoothness of weld metal and freedom from porosity and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth.

**3.02 HANGER AND SUPPORT SPACING**

- A. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
- B. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- C. Support riser piping independently of connected horizontal piping.
- D. Adjust hangers to obtain the slope specified in the piping section of this specification.
- E. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Max. Spacing
Steel	1/2" through 1-1/4"	6'-6"



Steel	1-1/2" through 6"	10'-0"
Copper	1/2" through 1-1/4"	5'-0"
Copper	1-1/2" and larger	8'-0"

**3.03 VERTICAL RISER CLAMPS**

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

**3.04 ANCHORS**

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

**3.05 EQUIPMENT CURBS**

- A. Secure bottom of support flat on roof deck. Secure equipment to curb in accordance with equipment manufacturer's instructions. Flashing and counter flashing by the General Contractor.
- B. Fill the entire void space with compressible fiberglass insulation.

**3.06 PIPE PENETRATION THROUGH ROOF**

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

END OF SECTION

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

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Contractor provide vibration isolators and flexible connections for the following equipment specified and indicated on the drawings:
  - a. Fans
  - b. Ductwork

**1.02 SECTION INCLUDES**

- A. This section includes specifications for vibration isolation material for equipment, piping systems, and duct systems. Included are the following topics:
  - 1. Type A: Neoprene Pad
  - 2. Type B: Neoprene Mount
  - 3. Type E: Spring Hanger with Neoprene
  - 4. Type S: Steel Base
  - 5. Type T: Horizontal Thrust Restraint
  - 6. Flexible Piping Connections

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Division 3 – Concrete
- C. Section 23 05 00 – Common Work Results for HVAC
- D. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- E. Section 23 11 00 – Facility Fuel Piping
- F. Section 23 34 00 – HVAC Fans
- G. Section 23 33 00 – Air Duct Accessories

**1.04 SUBMITTALS**

- A. Refer to Division 1, General Conditions, Submittals. At a minimum, provide submittals for the following items:
  - 1. Type A: Neoprene Pad
  - 2. Type B: Neoprene Mount
  - 3. Type E: Spring Hanger with Neoprene
  - 4. Type S: Steel Base
  - 5. Type T: Horizontal Thrust Restraint
  - 6. Flexible Piping Connections
- B. Include isolator type, materials of construction, isolator free and operating heights, and isolation efficiency based on the lowest operating speed of the equipment supported.

**1.05 QUALITY ASSURANCE**

- A. Refer to Division 1 for equals and substitutions.

**1.06 DESIGN CRITERIA**

- A. Isolate all motor driven mechanical equipment from the building structure and from the systems which they serve to prevent equipment vibrations from being transmitted to the structure. Consider equipment weight distribution to provide uniform isolator deflections.
- B. For equipment with variable speed capability, select vibration isolation devices based on the lowest speed.
- C. Credit will not be given for flexibility and vibration absorption characteristics of mechanical grooved pipe connections.
- D. Coordinate the selection of devices with the isolator and equipment manufacturers. All isolation material used by contractor shall be supplied by one manufacturer.

## **PART 2 – PRODUCTS**

### **2.01 MATERIALS**

- A. Use materials that will retain their isolation characteristics for the life of the equipment served. Use industrial grade neoprene for elastomeric materials.
- B. Treat all isolators to resist corrosion. For isolation devices exposed to the weather or used in high humidity areas, hot dip galvanize steel parts, apply a neoprene coating on all steel parts, or use stainless steel parts; include limit stops to resist wind.
- C. Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.
- D. Use isolators with a ratio of lateral to vertical stiffness not less than 1.0 or greater than 2.0.

### **2.02 VIBRATION ISOLATOR MANUFACTURERS**

- A. Mason Industries, Amber/Booth Co., Vibration Mounting & Controls, Peabody Noise Control.

### **2.03 TYPE A: NEOPRENE PAD**

- A. Neoprene waffle pad, 40 durometer with 16 gauge shims between layers.

### **2.04 TYPE B: NEOPRENE MOUNT**

- A. 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.

### **2.06 TYPE E: SPRING HANGER WITH NEOPRENE**

- A. 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.

### **2.07 TYPE S: STEEL BASE**

- A. 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.

### **2.08 TYPE T: HORIZONTAL THRUST RESTRAINT**

- A. Spring element in series with a neoprene pad as described for Type C 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.

### **2.09 PERFORMANCE**

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

Centrifugal Blowers:

Suspended: Use Type E-T hangers with deflection from blower minimum deflection guide. Type T needed only when air thrust exceeds 10% of equipment weight.

Floor mounted: Use Type C-IB mount with deflection from blower minimum deflection guide.

**2.10 BLOWER MINIMUM DEFLECTION GUIDE**

	-----Required Deflection (Inches)-----			
	On Grade	20' Floor Span	30' Floor Span	40' Floor Span
A. Fan Speed (RPM)				
1. 175-224	0.35	3.50	4.50	4.50
2. 225-299	0.35	3.50	3.50	3.50
3. 300-374	0.35	2.50	2.50	3.50
4. 375-499	0.35	1.50	2.50	3.50
5. 500 and over	0.35	0.75	1.50	2.50

**PART 3 – EXECUTION**

**3.01 INSTALLATION**

- A. Install seismic and vibration isolation devices in accordance with the manufacturer's installation instructions. The isolation manufacturer and the manufacturer's authorized representative shall be responsible for:
  - 1. Selection of the proper size and type of isolation materials.
  - 2. Preparation of the submittal material required.
  - 3. Field inspection of the installation and, if, necessary, accompanying the Architect/Engineer on a field inspection of the installation.
  - 4. Written certification that the isolation is installed and operating as designed.
- B. Unless otherwise noted on the equipment schedule, all mechanical equipment shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accord with weight distribution of the isolated equipment to provide reasonably uniform deflection. Deflections shall be provided by the equipment manufacturer.
- C. Bolt isolators to equipment and to supporting structure where isolator bolt holes are supplied.
- D. Shim or adjust leveling screws to level equipment. Shims shall not interfere with isolator action.
- E. Verify actual deflected height with design operating height and replace the isolator when they differ by 25% or more.
- F. Correct interferences with the isolator action or report to the Architect/Engineer when interference is caused by another contractor.

**3.02 ISOLATION DEVICES OUTDOORS OR IN HIGH HUMIDITY AREAS**

- A. Use only hot dip galvanized, stainless steel, or neoprene coated steel parts.

END OF SECTION

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

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Contractor provide:
  - 1. Have the temperature control manufacturer's representative set and adjust automatically operated devices to achieve specified sequence of operations.
  - 2. The balancing will be performed by a subcontractor retained by the Mechanical Contractor.

**1.02 SECTION INCLUDES**

- A. This section includes air testing, adjusting and balancing for the entire project. Included are the following topics:
  - 1. Performing Testing, Adjusting and Balancing

**1.03 RELATED WORK**

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and General Requirements in Division 1 govern work under this section.
- B. Section 23 05 00 – Common Work Results for HVAC
- C. Section 23 05 23 – General Duty Valves for HVAC Piping
- D. Section 23 07 00 – HVAC Insulation
- E. Section 23 09 14 – Pneumatic and Electric Instrumentation and Control Devices for HVAC

**1.04 SUBMITTALS**

- A. Refer to Division 1 for submittals. At a minimum, provide submittals for the following items:
  - 1. Testing, Adjusting and Balancing Report
- B. Submit testing, adjusting and balancing reports bearing the seal and signature of the NEBB or AABC Certified Test and Balance Supervisor. The reports certify that the systems have been tested, adjusted and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed and are operating; and are an accurate record of all final quantities measured to establish normal operating values of the systems.
- C. Submission: Distribute electronic copies of the Report to the Contractor, the Project Coordinator, Architect/Engineer, and the owner.
- D. Format: Cover page identifying project name, project number and descriptive title of contents. Divide the contents of the report into the below listed divisions:
  - 1. General Information
  - 2. Summary
  - 3. Air Systems
- E. Contents: Provide the following minimum information, forms and data:
  - 1. General Information: Inside cover sheet identifying Test and Balance Agency, Contractor, Architect, Engineer, Project Name and Project Number. Include addresses, contact names and telephone numbers. Also include a certification sheet containing the seal and signature of the Test and Balance Supervisor.
  - 2. Summary: Provide summary sheet describing mechanical system deficiencies. Describe objectionable noise or drafts found during testing, adjusting and balancing. Provide recommendations for correcting unsatisfactory performances and indicate whether modifications required are within the scope of the contract, are design related or installation related. List instrumentation used during testing, adjusting and balancing procedures.
  - 3. The remainder of the report to contain the appropriate standard NEBB or AABC forms for each respective item and system. Fill out forms completely. Where information cannot be obtained or is not applicable indicate same.
  - 4. Instruments:
    - a. Air balance instruments - Ranges shown are guides. Actual ranges used are subject to Architect/Engineer approval

- b. Velometer with probes and Pitot tube.
  - c. Rotating vane anemometer.
  - d. ASHRAE Standard Pitot tubes, stainless steel 5/16 outside diameter, lengths 18" and 36".
  - e. Magnehelic Differential Air Pressure Gauges, 0 to 0.5", 0 to 1.0" and 0 to 5.0" water pressure ranges, each arranged as a portable unit for use with a standard Pitot tube.
  - f. Combination inclined-vertical portable manometer, range 0 to 5.0" water.
  - g. Portable type hook gage, range 0 to 12" water.
  - h. Portable flexible U-tube manometer, magnetic mounting clips, range 0 to 18" water.
  - i. Conical or pyramidal shaped hood.
5. System performance measuring instruments:
- a. Insertion thermometers, with graduations at 0.5° F.
  - b. Sling Psychrometer.
  - c. Tachometer, Centrifugal Type
  - d. Revolution Counter
  - e. Clamp-On Volt-Ammeter
  - f. Recorders, Portable Type for temperature and humidity.

#### **1.05 REFERENCE STANDARDS**

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

#### **1.06 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. An independent Firm specializing in the Testing and Balancing of HVAC systems for a minimum of 3 years. A Firm not engaged in the commerce of furnishing or providing equipment or material generally related to HVAC work other than that specifically related to installing Testing and Balancing components necessary for work in this section such as, but not limited to sheaves, pulleys, and balancing dampers.
  - 2. A certified member of AABC or certified by NEBB in the specific area of work performed. Maintain certification for the entire duration of the project. If certification of firm or any staff performing work is terminated or expires during the duration of the project, contact owner immediately.
  - 3. Submit Qualifications of firm and project staff to the owner upon request.

#### **1.07 DESCRIPTION**

- A. Provide total mechanical systems testing, adjusting and balancing. Requirements include the balance of air distribution, adjustment of new and existing systems and equipment to provide design requirements indicated on the drawings, electrical measurement and verification of performance of all mechanical equipment, all in accordance with standards published by AABC or NEBB.
- B. Test, adjust and balance all air so that each room, piece of equipment or terminal device meets the design requirements indicated on the drawings and in the specifications.
- C. Accomplish testing, adjusting and balancing work in a timely manner that allows partial occupancy of major buildings, occupancy of one building when the project involves many buildings, and completion of the entire project in the time stated in the Instruction to Bidders and in accordance with the completion schedule established for this project.
- D. Verify that provisions are being made to accomplish the specified testing, adjusting and balancing work. If problems are found, handle as specified in Part 3 under Deficiencies.

#### **1.08 PRE-INSTALLATION MEETING AND SCHEDULING**

- A. The test and balance agency is required to attend a pre-installation meeting with all other project contractors before the construction process is started. The test and balance agency shall give the Lead Contractor a detailed schedule of testing and balancing tasks for incorporation into the project schedule. Reference General Conditions Division 1 for Lead Contractor responsibilities for scheduling.



### **1.09 PRE-BALANCE CONFERENCE**

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

## **PART 2 – PRODUCTS**

### **2.01 INSTRUMENTATION**

- A. Provide all required instrumentation to obtain proper measurements. Application of instruments and accuracy of instruments and measurements to be in accordance with the requirements of NEBB or AABC Standards and instrument manufacturer's specifications.
- B. All instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination by owner upon request. Calibration and maintenance of all instruments to be in accordance with the requirements of NEBB or AABC Standards.

## **PART 3 – EXECUTION**

### **3.01 DAILY REPORTS**

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

### **3.02 PRELIMINARY PROCEDURES**

- A. Review preconstruction meeting report, applicable construction bulletins, applicable change orders and approved shop drawings of equipment, outlets/inlets and temperature controls.
- B. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals. Inspect all systems components for proper installation and operation. Use manufacturer's ratings for all equipment to make calculations except where field test shows ratings to be impractical. Verify that all instruments are accurately calibrated and maintained.
- C. Check filters for cleanliness, dampers and valves for correct positioning, equipment for proper rotation and belt tension, temperature controls for completion of installation.
- D. Notify owner on a daily basis during balancing. Identify deficiencies preventing completion of testing, adjusting and balancing procedures. Do not proceed until systems are fully operational with all components necessary for complete testing, adjusting and balancing. Installing Contractors are required to provide personnel to check and verify system completion, readiness for balancing and assist Balancing Agency in providing specified system performance.

### **3.03 PERFORMING TESTING, ADJUSTING AND BALANCING**

- A. Perform testing, adjusting and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards except as may be modified below.
- B. In areas containing ceilings, remove ceiling tile to accomplish balancing work; replace tile when work is complete and provide new tile for any tile that are damaged by this procedure. If the ceiling construction is such that access panels are required for the work of this section and the panels have not been provided, inform the owner.
- C. Cut insulation, ductwork for installation of test probes to the minimum extent necessary for adequate performance of procedures. Patch using materials identical to those removed, maintaining vapor barrier integrity and pressure rating of systems.
- D. In air systems employing filters, blank off sufficient filter area to simulate a pressure drop that is midway between that of a clean filter and that of a dirty filter.
- E. Measure and record system measurements at the fan to determine total flow. Adjust equipment as required to yield specified total flow at terminals. Proceed taking measurements in mains and branches

as required for final terminal balancing. Test and record motor full load amperes and current draw. Test and record system static pressure suction and discharge. Perform terminal balancing to specified flows balancing branch dampers, deflectors, extractors and valves prior to adjustment of terminals.

- F. Measure and record static air pressure conditions across fans and filters. Indicate in report if filter measurements were made on a clean or dirty filter.
- G. Adjust register, grille and diffuser vanes and accessories to achieve proper air distribution patterns and uniform space temperatures free from objectionable noise and drafts within the capabilities of the installed system.
- H. Provide fan and motor drive sheave adjustments necessary to obtain design performance. Provide drive changes specifically noted on drawings, if any. If work of this section indicates that any drive or motor is inadequate for the application, advise the engineer by giving the engineer properly sized motor/drive information (in accordance with manufacturers original service factor and installed motor horsepower requirements); Confirm any change will keep the duct/piping system within its design limitations with respect to speed of the device and pressure classification of the distribution system.
- I. Areas or rooms designed to maintain positive, negative or balanced air pressures with respect to adjacent spaces, as indicated by the design air quantities, require special attention. Adjust fan drives, distribution dampers, terminals and controls to maintain indicated pressure relationship.
- J. Final air system measurements to be within the following range of specified cfm:
  - 1. Fans 0% to +10%
  - 2. Supply grilles, registers, diffusers 0% to +10%
  - 3. Return/exhaust grilles, registers 0% to -10%
  - 4. Room pressurization air -5% to +5%
- K. Contact the temperature control contractor for assistance in operation and adjustment of controls during testing, adjusting and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation and any deficiencies found.
- L. Permanently mark equipment settings, including damper positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.
- M. Leave systems in proper working order, replacing belt guards, closing access doors and electrical boxes, and restoring temperature controls to normal operating settings.

### **3.04 DEFICIENCIES**

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

END OF SECTION

**SECTION 23 07 00  
HVAC INSULATION**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Contractor provide:
  - 1. Duct covering liner for all insulated ductwork.
  - 2. Duct covering insulation for all supply air ductwork, all outside air, all make-up air, all return air, all relief air, all exhaust air (within 30' of fan inlet and outlet), and all plenum ductwork.

**1.02 SECTION INCLUDES**

- A. This section includes insulation specifications for heating, ventilating and air conditioning piping, ductwork and equipment. Included are the following topics:
  - 1. Insulation Types
    - a. Flexible Fiberglass Insulation
    - b. Rigid Fiberglass Insulation
    - c. Fire-Stop Insulation
  - 2. Metal Covering and Jackets
    - a. All Service Jackets (ASJ)
    - b. Foil Scrim All Service Jackets (FSJ)
    - c. Protective Metal Jackets (PMJ)
    - d. Fabric Reinforced Mastic Jackets (FMJ)
  - 3. Accessories

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 23 05 00 – Common Work Results for HVAC
- C. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- D. Section 23 11 00 – Facility Fuel Piping
- E. Section 23 31 00 – HVAC Ducts and Casings

**1.04 SUBMITTALS**

- A. Refer to Division 1 for submittals. At a minimum, provide submittals for the following items:
  - 1. Insulation Types
    - a. Flexible Fiberglass Insulation
    - b. Rigid Fiberglass Insulation
    - c. Fire-Stop Insulation
  - 2. Metal Covering and Jackets
    - a. All Service Jackets (ASJ)
    - b. Foil Scrim All Service Jackets (FSJ)
    - c. Protective Metal Jackets (PMJ)
    - d. Fabric Reinforced Mastic Jackets (FMJ)
  - 3. Accessories
- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

**1.05 REFERENCE STANDARDS**

- A. ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate
- B. ASTM C165 Test Method for Compressive Properties of Thermal Insulations
- C. ASTM C177 Heat Flux and Thermal Transmission Properties
- D. ASTM C195 Mineral Fiber Thermal Insulation Cement
- E. ASTM C240 Cellular Glass Insulation Block

F.	ASTM C302	Density of Preformed Pipe Insulation
G.	ASTM C303	Density of Preformed Block Insulation
H.	ASTM C355	Test Methods for Test for Water Vapor Transmission of Thick Materials
I.	ASTM C449	Mineral Fiber Hydraulic Setting Thermal Insulation Cement
J.	ASTM C518	Heat Flux and Thermal Transmission Properties
K.	ASTM C553	Mineral Fiber Blanket and Felt Insulation
L.	ASTM C610	Expanded Perlite Block and Thermal Pipe Insulation
M.	ASTM C612	Mineral Fiber Block and Board Thermal Insulation
N.	ASTM C921	Properties of Jacketing Materials for Thermal Insulation
O.	ASTM D1000	Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
P.	ASTM D1621	Standard Test Method for Compressive Properties Of Rigid Cellular Plastics
Q.	ASTM D1622	Standard Test Method for Apparent Density of Rigid Cellular Plastics
R.	ASTM D1940	Method of Test for Porosity of Rigid Cellular Plastics
S.	ASTM D2126	Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
T.	ASTM E84	Surface Burning Characteristics of Building Materials
U.	ASTM E814	Standard Test Method for Fire Tests of Penetration Firestop Systems
V.	ASTM E2336	Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems
W.	MICA	National Commercial & Industrial Insulation Standards
X.	NFPA 225	Surface Burning Characteristics of Building Materials
Y.	UL 723	Surface Burning Characteristics of Building Materials

#### **1.06 QUALITY ASSURANCE**

- A. Refer to Division 1 equals and substitutions
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.
- C. Insulation systems shall be applied by experienced contractors. Within the past five (5) years, the contractor shall be able to document the successful completion of a minimum of three (3) projects of at least 50% of the size and similar scope of the work specified in this section.

#### **1.07 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified in Section 23 05 00 – Common Work Results for HVAC.

#### **1.08 DESCRIPTION**

- A. Furnish and install all insulating materials and accessories as specified or as required for a complete installation. The following types of insulation are specified in this section:
  1. Duct Insulation
- B. Install all insulation in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions. Exceptions to these standards will only be accepted where specifically modified in these specifications, or where prior written approval has been obtained from the Owner.

#### **1.09 DEFINITIONS**

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

#### **1.10 ENVIRONMENTAL REQUIREMENTS**

- A. Do not store insulation materials on grade or where they are at risk of becoming wet. Do not install insulation products that have been exposed to water.
- B. Protect installed insulation work with plastic sheeting to prevent water damage.
- C. Delivery, Storage And Handling:
  1. Deliver field applied material to site in factory fabricated containers with manufacturer's stamp or label showing fire hazard rating of products.
  2. Store in original wrappings and protect from weather and construction traffic.
  3. Protect against dirt, water, chemical and mechanical damage.

4. Remove damaged insulation from project site, do not install.

## **PART 2 – PRODUCTS**

### **2.01 MATERIALS**

- A. Manufacturers: Armacell, Certainteed, Manson, Childers, Dow, Extol, Fibrex, Halstead, H.B. Fuller, Imcoa, Johns Manville, Knauf, Owens-Corning, Partek, Pittsburgh Corning, Rubatex, VentureTape.
- B. Materials or accessories containing asbestos will not be accepted.
- C. Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less when tested in accordance with ASTM E84, NFPA 255 or UL 723, with the following exceptions:
- D. Pipe insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke developed rating no higher than 450 when tested in accordance with UL 723 and ASTM E84.

### **2.02 INSULATION TYPES**

- A. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.
- B. Flexible Fiberglass Insulation: Minimum nominal density of 0.75 lbs. per cu. ft., and thermal conductivity of not more than 0.3 at 75 degrees F, rated for service to 250 degrees F.
- C. Rigid Fiberglass Insulation: Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.
- D. Fire-Stop Insulation:
  1. Noncombustible, non-asbestos, non-ceramic fiber, high temperature blanket or board fireproofing insulation, constructed of calcium silicate or calcium/magnesium/silica amorphous wool with 2-hour ASTM E814 “F” and “T” fire ratings, UL or equivalent third party listed, labeled and specifically evaluated for such purpose in accordance with ASTM E2336. Foil-scrim-polyethylene fiberglass reinforced factory applied jacket.

### **2.03 JACKETS**

- A. Foil Scrim All Service Jackets (FSJ): Glass fiber reinforced foil kraft laminate, factory applied to insulation. Maximum permeance of .02 perms and minimum beach puncture resistance of 25 units.
- B. Protective Metal Jackets (PMJ): .016 inch thick pebble finish aluminum or .010 inch thick stainless steel with safety edge.
- C. Fabric Reinforced Mastic Jackets (FMJ): Glass fiber reinforcing fabric imbedded in weather barrier mastic as per manufacturer’s recommended procedure for 2 coat application.

### **2.04 ACCESSORIES**

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be .015 inch for aluminum and .010 inch for stainless steel.
- D. Tack fasteners to be stainless steel ring grooved shank tacks.
- E. Staples to be clinch style.
- F. Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.
- G. Finishing cement to be ASTM C449.
- H. Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.
- I. Bedding compounds to be non-shrinking and permanently flexible.
- J. Vapor barrier coatings to have maximum applied water vapor permeance of .05 perms.
- K. Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.

## **PART 3 – EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that all piping, equipment, and ductwork are tested and approved prior to installing insulation. Do not insulate systems until testing and inspection procedures are completed.
- B. Verify that all surfaces are clean, dry and without foreign material before applying insulation materials.

### **3.02 INSTALLATION**

- A. All materials shall be installed by skilled labor regularly engaged in this type of work. All materials shall be installed in strict accordance with manufacturer's recommendations, building codes, and industry standards. Do not install products when the ambient temperature or conditions are not consistent with the manufacturer's recommendations. Surfaces to be insulated must be clean and dry. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements. Maintain temperature during and after installation for minimum period of 24 hours.
- B. Locate insulation and cover seams in the least visible location. All surface finishes shall be extended in such a manner as to protect all raw edges, ends and surfaces of insulation.
- C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.
- D. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.
- E. Use full length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.
- F. Existing or new insulation damaged and/or removed by the Contractor during remodeling work shall be repaired or replaced with new insulation as directed by the Owner.
- G. All pipe and duct insulation shall be continuous through walls, ceiling or floor openings and through sleeves except where firestop or firesafing materials are required. Vapor barriers shall be maintained continuous through all penetrations.
- H. Provide a continuous unbroken moisture vapor barrier on insulation applied to systems noted below. Attachments to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- I. Provide a complete vapor barrier for insulation on the following systems:
  - 1. Insulated Duct
  - 2. Equipment, ductwork or piping with a surface temperature below 65 degrees F

### **3.03 PROTECTIVE JACKET INSTALLATION**

- A. Protective Metal Jacket (PMJ): Lap seams a minimum of 2 inches. Secure with metal bands for end to end joints, and rivets or sheet metal screws for longitudinal joints. Rivets, screws, and bands to be constructed of the same material as the jacket. Locate seams on bottom for exterior applications.
- B. Fabric Reinforced Mastic Jackets (FMJ): Glass fiber fabric shall be fitted without wrinkles. Glass fiber fabric shall be sized immediately upon application with lagging adhesive and shall be capable of drying within 6 hrs. Apply adhesive and coating in accordance with manufacturer's recommendations. All seams shall overlap not less than 2".

### **3.04 DUCT INSULATION**

- A. General:
  - 1. Secure flexible duct insulation on sides and bottom of ductwork over 24" wide and all rigid duct insulation with weld pins. Space fasteners 18" on center or less as required to prevent sagging.
  - 2. Secure rigid board insulation to ductwork with weld pins. Apply insulation with joints firmly butted as close as possible to the equipment surface. Pins shall be located a maximum of 3" from each edge and spaced no greater than 12" on center.
  - 3. Install weld pins without damage to the interior galvanized surface of the duct. Clip pins back to washer and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with 4" tape of same material as jacket. Seal tape with plastic applicator and secure with staples. All joints, seams, edges and penetrations to be fully vapor sealed.
  - 4. Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation or jacket material.

5. Where insulated ductwork is supported by trapeze hangers, the insulation shall be installed continuous through the hangers. Drop the supporting channels required to facilitate the installation of the insulation. Where rigid board or flexible insulation is specified, install high density inserts to prevent the weight of the ductwork from crushing the insulation.
  6. Where insulated low temperature (below 45°F) ductwork is supported by steel metal straps or wire ropes that are secured directly to the duct, the straps or ropes shall be completely covered with insulation and sealed to provide a complete vapor barrier.
  7. Where insulated duct risers are supported by steel channels secured directly to the duct, extend the insulation and vapor barrier jacketing to encapsulate the support channels.
- B. Grease Ducts: Strictly adhere to manufacturer's installation instructions and rating requirements for application of fire-stop insulation. Cover all exhaust ducts serving Type I kitchen hoods with fire-stop insulation from a point prior to penetration of ceiling, wall, floor or concealment through building to termination at outside of building. Extend fire-stop insulation through roof curbs.

**3.05 DUCTWORK PROTECTIVE COVERINGS**

- A. In addition to the jackets specified in the duct insulation schedule below the following protective coverings are required:
1. Provide a protective covering of 2 coats of indoor/outdoor vapor barrier mastic with metal jacket or canvas fabric covering (FMJ) for the following ductwork: Ductwork within 6' of floor.

**3.06 DUCT INSULATION SCHEDULE**

- A. Provide duct insulation on new and existing remodeled ductwork in the following schedule:

<b>Service</b>	<b>Insulation Type</b>	<b>Jacket</b>	<b>Insulation Thickness</b>
Outside air ducts	Rigid Fiberglass	FSJ	2"
Mixed air ducts	Rigid Fiberglass	FSJ	2"
Exposed supply ducts*	Rigid Fiberglass	FSJ	2"
Concealed supply ducts	Flexible Fiberglass	FSJ	2"
Ductwork in unconditioned space	Rigid Fiberglass	FSJ	2"
All Ducts located in unconditioned Exhaust and relief ducts downstream of motorized backdraft dampers	Rigid Fiberglass	FSJ	2"
Grease ducts serving Type I Kitchen hoods	Fire-Stop	See Spec.	As Req'd. for Specified Hourly Rating
Louver blank-off panels	Rigid Fiberglass	FSJ	2"

END OF SECTION

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**SECTION 23 09 14**  
**PNEUMATIC AND ELECTRIC INSTRUMENTATION AND CONTROL DEVICES FOR HVAC**

**PART 1 - GENERAL**

**1.01 SCOPE OF WORK**

- A. Unless noted otherwise, the Temperature Control Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes control system specifications for all HVAC work as well as related electric control for systems found in other specification sections. Included are the following topics:
  - 1. Control Dampers
  - 2. Electric/Electronic Thermostats
  - 3. Temperature Sensors
  - 4. Power Supplies

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 23 05 00 – Common Work Results for HVAC
- C. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC - Coordination
- D. Section 23 31 00 – HVAC Ducts
- E. Section 23 33 00 – Ductwork Accessories - for control damper installation
- F. Division 23 - HVAC - Equipment provided to be controlled or monitored
- G. Division 26 – Electrical – Installation requirements & Equipment provided to be controlled or monitored
- H. Division 28 - Electronic Safety and Security

**1.04 SUBMITTALS**

- A. Refer Section 23 05 00 – Common Work Results for HVAC, Submittals. In addition to the general content specified under Section 23 05 00 – Common Work Results for HVAC, supply the following submittals:
  - 1. Control Dampers
  - 2. Electric/Electronic Thermostats
  - 3. Temperature Sensors
  - 4. Power Supplies
- B. Include the following information:
  - 1. Manufacturer's data sheets indicating model number, pressure/temperature ratings, capacity, methods and materials of construction, installation instructions, and recommended maintenance. General catalog sheets showing a series of the same device is not acceptable unless the specific model is clearly marked.
  - 2. Schematic flow diagrams of systems showing fans, dampers, and other control devices. Label each device with setting or adjustable range of control. Indicate all wiring, clearly, differentiating between factory and field installed wiring. Wiring should be shown in schematics that detail contact states, relay references, etc. Diagrammatic representations of devices alone are not acceptable.
  - 3. Details of construction, layout, and location of each temperature control panel within the building, including instruments location in panel and labeling. Also include on drawings location of mechanical equipment controlled (room number), horsepower and flow of motorized equipment (when this data is available on plans), locations of all remote sensors and control devices (either by room number or column lines).
  - 4. Schedule of control dampers indicating size, leakage rating, arrangement, pressure drop at design airflow, and number and size of operators required.
  - 5. A complete description of each control sequence for equipment that is not controlled by direct digital controls.

- C. Prior to request for final payment, submit record documents which accurately record actual location of control components including panels, thermostats, wiring, and sensors. Incorporate changes required during installation and start-up.
- D. All submittals are to comply with submission and content requirements specified in specification Division 1.

#### **1.05 REFERENCE STANDARDS**

- A. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
- B. ANSI/ASTM B32 Specification for Solder Metal
- C. ASTM B75 Seamless Copper Tube
- D. ASTM D1693 Environmental Stress-Cracking of Ethylene Plastics
- E. ASTM D 635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
- F. UL 94 Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
- G. AMCA 500-D Laboratory Method of Testing Dampers for Rating
- H. ASHRAE Guideline 16-2010 Selecting Outdoor, Return and Relief Dampers for Air-Side Economizer Systems

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturers: Installing contractor must be an authorized representative equipment manufacturer that provides engineering and commissioning of the equipment. Direct Digital Control (DDC) equipment may or may not be required to be installed by this contractor as part of the project, but the intent of this quality assurance specification is to ensure that the installing contractor has the capabilities to engineer, install, and commission the field devices supplied under this section for temperature control.

#### **1.07 DESIGN CRITERIA**

- A. Size all control apparatus to properly supply and/or operate and control the apparatus served. For example damper and valve actuators shall have sufficient power to operate their respective valve or damper from 0 to 100% under load smoothly, without jerking or hysteresis.
- B. Provide control devices subject to corrosive environments with corrosion protection or construct them so they are suitable for use in such an environment.
- C. Provide devices exposed to outside ambient conditions with weather protection or construct them so they are suitable for outdoor installation.
- D. Use only UL labeled products that comply with NEMA Standards. Electrical components and installation to meet all requirements of the electrical sections (Division 26) of project specifications.

#### **1.08 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified in Section 23 05 00 – Common Work Results for HVAC.
- B. In addition to the general content specified Section 23 05 00 – Common Work Results for HVAC, supply the following additional documentation:
  - 1. Lubrication instructions, including list/frequency of lubrication
  - 2. List indicating types and grades of oil and/or grease, packing materials, normal and abnormal tolerances for devices, and method of equipment adjustment
  - 3. Table noting full load power factor, service factor, NEMA design designation, insulation class and frame type for each motor provided
  - 4. A complete set of record drawings

#### **1.09 DELIVERY, STORAGE AND HANDLING**

- A. Provide factory shipping cartons for each piece of equipment and control device. This contractor is responsible for storage of equipment and materials inside and protected from the weather.

#### **1.10 SYSTEM DESCRIPTION**

- A. System is to be electric/electronic.

**1.11 DEMOLITION**

- A. Where existing control devices, piping, or wiring are discontinued from use, remove and turn over to owner. If owner does not want them remove from premises. Remove any previously abandoned control devices in a similar manner.

**PART 2 – PRODUCTS**

**2.01 CONTROL DAMPERS**

- A. Provide control dampers shown on the plans and as required to perform the specified functions. Dampers shall be rated for velocities that will be encountered at maximum system design and rated for pressure equal to or greater than the ductwork pressure class of the ductwork where the damper is installed, as specified in Section 23 31 00 – HVAC Ducts and Casings.
- B. Use only factory fabricated dampers with mechanically captured replaceable resilient blade seals, stainless steel jamb seals and with entire assembly suitable for the maximum temperature and air velocities encountered in the system.
- C. All dampers in stainless steel, PCD coated steel, PVC, PTFE, or fiberglass ductwork shall be constructed of stainless steel.
- D. All dampers in aluminum ductwork shall be constructed of stainless steel or aluminum.
- E. Dampers in galvanized ductwork shall be constructed of galvanized steel and/or aluminum.
- F. All dampers, unless otherwise specified, to be rated at a minimum of 180° F working temperature. Leakage testing shall be certified to be based on latest edition of AMCA Standard 500-D and all dampers, unless otherwise specified, shall have leakage ratings as follows:

Damper Class	Differential Pressure	Leakage
Class IA	1” w.g.	≤3 CFM/ft <sup>2</sup>
Class I	4” w.g.	≤8 CFM/ft <sup>2</sup>
- G. Leakage rate dampers for differential pressures that they will encounter at maximum system design pressures.
- H. Steel framed dampers: Nailor models 2010 & 2020; Greenheck models VCD-33 & VCD-42; Johnson Controls model V-1330; Ruskin Models CD60 & CD40.
- I. Aluminum frame and blade dampers: Nailor models 2010EAF & 202EAF; Greenheck model VCD-43; Ruskin model CD50; Arrow model AFD-20.
- J. Dampers used for directed mixing of airstreams, i.e. outside air and return air, to be parallel blade type and sized for an air velocity of 1800 to 2000 fpm with the damper blades shall be arranged so that the air streams are directed at one another to facilitate mixing. Dampers used for throttling or modulating applications other than air stream mixing to be opposed blade type. Two position dampers may be parallel or opposed blade type.
- K. Dampers used for isolation on the discharge of centrifugal fans shall have damper blades perpendicular to the fan shaft to minimize system effect. Dampers mounted with blades vertically shall be designed for vertical blade orientation.
- L. Dampers for applications to have frames of not less than 16 gauge galvanized steel or 12 gauge extruded aluminum. Blades to be two-ply steel airfoil of not less than 2 x 20 gauge galvanized steel (14 gauge equivalent) or extruded aluminum airfoil, with stainless steel, acetal, Celcon, bronze, or nylon bearings. Maximum allowable blade width is 8 inches. Use plated steel linkage hardware.
- M. Maximum damper width is 48 inches; where required width exceeds 48 inches, use multiple damper sections. Inside frame free area shall be a minimum of 90% of total inside duct area.
- N. Multiple width damper sections shall utilize jack shaft linkages unless noted below. Double width damper sections for two-position operation may be actuated without jack shafts if each damper section is actuated separately. Dampers that have multiple width and multiple vertical sections shall have a jackshaft for each vertically stacked set of dampers and be provided with crossover linkages between jack shafts to transfer uneven loading.
- O. Jack shafts shall be extended outside of the ductwork for external actuator mounting. Provide bearings on the point of exit for support of damper shafts to prevent wear on the shaft and the ductwork. If locating actuators out of the air stream is impossible, obtain mounting location approval from the A/E unless the contract documents indicate in air stream mounting is acceptable. In no cases shall damper

actuators for fume exhaust systems be located in the air stream or require entering the air stream to service an actuator.

- P. Provide weatherproof NEMA 4 enclosures (Belimo N4 option, Belimo ZS-100 or ZS-150 are not acceptable) that have removable covers that have clasps or machine screws (no sheet metal screws) and that do not require removing fasteners from the ductwork to prevent actuator failure or freeze-up when mounting in locations exposed to harsh environments or outdoor locations.
- Q. Size operators for smooth and positive operation of devices served, and with sufficient torque capacity to provide tight shutoff against system temperatures and pressure encountered.
  - 1. For electric modulating actuation, use fully proportional actuators with zero and span adjustments.
  - 2. For two-position electric actuation use 24 VAC for DDC controlled actuators, 120 VAC actuators may be used for hardwire interlocking.
- R. Refer to drawings for specific type of input signal required. All electric actuators will be provided with overload protection to prevent motor from damage when stall condition is encountered. Equip operators with spring return or stored energy fail-safe return for applications involving fire, freeze protection, moisture protection or specified normally open/closed operation.
- S. All power required for electric actuation shall be provided by this contractor.
- T. Provide operators with linkages and brackets for mounting on device served.
- U. All outdoor air, return air, and relief air dampers to be sized in accordance with the ASHRAE Guideline 16-2010.
- V. Damper Actuators:
  - 1. Analog Electronic: Actuators shall be hydraulic or electric motor/gear drives that respond proportionally to analog voltage or current input. Stroke time for major equipment shall be 90 seconds or less for 90° rotation. Stroke time for terminal equipment shall be compatible with associated local controller, but no more than 6 minutes. Provide spring return feature for fail open or closed positions, as required by control sequence, for critical applications such as outside, return, or exhaust dampers, heating and cooling coils on major air handling units, humidifiers, heat exchangers, flow control for major equipment items such as chillers, cooling towers, boilers, etc. Provide position feedback potentiometers connected to controller for closed loop control on major equipment analog control loops. Actuators for terminal heating/cooling equipment do not require spring return feature. Manufacturers: Belimo, Honeywell, Johnson Controls, Siemens Building Technologies or Invensys Building Systems.
  - 2. Discrete Two-Position Electric: Actuators shall be hydraulic or electric motor/gear drives for two-position control. Stroke time shall be 90 seconds or less for 90° rotation. Provide spring return feature for fail open or closed positions as required by control sequence. Manufacturers: Belimo, Honeywell, Johnson Controls, Siemens Building Technologies or Invensys Building Systems.

## **2.02 ELECTRIC/ELECTRONIC THERMOSTATS**

- A. Electric Thermostats: For single setpoint applications, provide line or low voltage electric type suitable for heating or heating and cooling as required. Provide the required number of heating and/or cooling stages required for the application. For line voltage ventilation applications utilizing fans and where otherwise specified in the sequence of operations, provide an integral manual On/Off/Auto selector switch. Minimum contact rating shall be equal to electrical load of device being controlled.
- B. Low Voltage Electronic Thermostats:
  - 1. Manufacturers: Honeywell, Johnson Controls, Viconics.
  - 2. Where unoccupied setpoints are specified, provide electronic programmable type with seven day setup/setback scheduling with a minimum of two occupied and unoccupied schedules per day through keypad entry on front of unit. For heating and cooling applications, provide automatic heating/cooling switchover. For applications that control fans, provide fan override switch. For ventilation or packaged economizer applications provide a dry contact for ventilation damper or economizer initiation. For thermostat control of economizer, provide a 0-10VDC modulated output for economizer damper control.
  - 3. For applications that require integration to the building automation system, provide a BACnet communication interface. If a communication interface is specified, occupancy scheduling in the thermostat is not required.

**2.03 TEMPERATURE SENSORS**

- A. Thermistor temperature sensor manufacturers: PreCon, BAPI, and ACI
- B. Use thermistor or RTD type temperature sensing elements constructed so accuracy and life expectancy is not affected by moisture, physical vibration, or other conditions that exist in each application.
- C. RTD's shall be of nickel or platinum construction and have a base resistance of 1000Ω at 70°F and 77°F respectively. 100Ω platinum RTD's are acceptable if used with temperature transmitters.
- D. The temperature sensing device used must be compatible with the DDC controllers used on the project.
  - RTD
    - Accuracy (Room Sensor Only) minimum ± 1.0°F
    - Accuracy (Averaging) minimum ± 1.2°F
    - Accuracy (Other than Room Sensor or Averaging) minimum ± 0.65°F
    - Range minimum -40 - 220°F
  - Thermistor
    - Accuracy (All) minimum ± 0.36°F
    - Range minimum -30 - 230°F
    - Heat Dissipation Constant minimum 2.7 mW/°C
  - Temperature Transmitter
    - Accuracy minimum ± 0.1°F or ±0.2% of span
    - Output 4-20 mA
- E. Use wire size appropriate to limit temperature offset due to wire resistance to 1.0°F. If offset is greater than 1.0°F due to wire resistance, use temperature transmitter. If feature is available in DDC controller, compensate for wire resistance in software input definition.

**2.05 POWER SUPPLIES**

- A. Provide all required power supplies for transducers, sensors, transmitters and relays. All low voltage transformers shall have a resettable secondary circuit breaker and be listed as class 2 power supplies.

**PART 3 – EXECUTION**

**3.01 INSTALLATION**

- A. Install system with trained mechanics and electricians employed by the control equipment manufacturer or an authorized representative of the manufacturer. Where installing contractor is an authorized representative of the control manufacturer, such authorization shall have been in effect for a period of no less than three years.
- B. Install all control equipment, accessories, wiring, and piping in a neat and workmanlike manner. All control devices must be installed in accessible locations. This contractor shall verify that all control devices furnished under this Section are functional and operating the mechanical equipment as specified.
- C. Label all control devices with the exception of dampers, valves, and terminal unit devices with permanent printed labels that correspond to control drawings. Temperature control junction and pullboxes shall be identified utilizing spray painted green covers. Other electrical system identification shall follow the Division 26 identification specification requirements.
- D. All control devices and electrical boxes mounted on insulated ductwork shall be mounted over the insulation. Provide mounting stand-offs where necessary for adequate support. Cutting and removal of insulation to mount devices directly on ductwork is not acceptable. This contractor shall coordinate with the insulation contractor to provide for continuous insulation of ductwork.
- E. Mounting of electrical or electronic devices shall be protected from weather if the building is not completely enclosed. This Contractor shall be solely responsible for replacing any equipment that is damaged by water that infiltrates the building if equipment is installed prior to the building being enclosed.
- F. Provide all electrical relays and wiring, line and low voltage, for control systems, devices and components. Install all high voltage and low voltage wiring (includes low voltage cable) in metal conduit, Electrical Non-metallic Tubing (ENT), or Electrical Metallic Tubing (EMT), as scheduled below and hereafter referred to generically as conduit. See Wire and Air Piping Conduit Installation

Schedule below for specific conduit or tubing to be used. All conduit must be installed in accordance with electrical sections (Division 26) of this specification and the National Electrical Code.

- G. Conduit shall be a minimum of 1/2 " for low voltage control provided the pipe fill does not exceed 40%.
- H. Minimum low voltage wiring gauge to be 18 AWG for outputs and 20 AWG for inputs. All low voltage wiring to be stranded.
- I. Low voltage wiring can be run without conduit above accessible lay-in tile ceilings. All wiring in mechanical rooms, above inaccessible hard ceilings, exterior locations, and in any exposed areas, and in all other locations should be in conduit. Wire for wall sensors must be run in conduit.
- J. Where wiring is installed free-air, installation shall consider the following:
  - 1. Wiring shall utilize the cable tray wherever possible.
  - 2. Wiring shall run at right angles and be kept clear of other trades work.
  - 3. Wiring shall be supported utilizing "J" or "Bridal-type" steel mounting rings anchored to ceiling concrete, piping supports, walls above ceiling or structural steel beams. Mounting rings shall be of open design (not a closed loop) to allow additional wire to be strung without being threaded through the ring. For mounting rings that do not completely surround the wire, attach the wire to the mounting ring with a strap.
  - 4. Supports shall be spaced at a maximum 4-foot interval unless limited by building construction. If wiring "sag" at mid-span exceeds 6-inches; another support shall be used.
  - 5. Wiring shall never be laid directly on the ceiling grid or attached in any manner to the ceiling grid wires.
  - 6. Wall penetrations shall be sleeved.
- K. Wiring shall not be attached to existing cabling, existing tubing, piping, ductwork, ceiling supports or electrical or communications conduit.
- L. Control panels serving equipment fed by emergency power shall also be served by emergency power.
- M. This contractor shall be responsible for all 120VAC power, not provided in the Division 26 specifications, required for equipment provided under this section.
- N. Install "hand/off/auto" selector switches on systems where automatic interlock controls are specified and "hand/off/auto" selector switches are not supplied with the equipment controlled. Control panel power will not be required for "hand" switch to operate. When switch is in "hand" position, allow manual operation of the selected device without operating the interlocked motors but allowing all unit safety devices to stay in the circuit.
- O. After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.

### **3.02 WIRE AND AIR PIPING CONDUIT AND TUBING INSTALLATION SCHEDULE**

- A. The following conduit schedule shall apply to both polyethylene tubing and wire in conduit where conduit is specified for air tubing or wiring. Conduit and tubing referenced below shall meet specifications in Division 26 and as defined below.
- B. Conduit other than that specified below for specific applications shall not be used.
- C. Underground Installations within Five Feet (1.5 m) of Foundation Wall: Rigid steel conduit.
- D. Underground Installations More than Five Feet (1.5 m) From Foundation Wall: Rigid steel conduit. Plastic-coated rigid steel conduit. Schedule 40 PVC conduit.
- E. Under Slab on Grade Installations: Schedule 40 PVC conduit.
- F. Exposed Outdoor Locations: Rigid steel conduit.
- G. Concealed in Concrete and Block Walls: Rigid steel conduit. Schedule 40 PVC conduit. Electrical Nonmetallic Tubing (ENT).
- H. Within Concrete Slab: Rigid steel conduit. Schedule 40 PVC conduit. Electrical Nonmetallic Tubing (ENT).
- I. Wet Interior Locations: Rigid steel conduit.
- J. Concealed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
- K. Exposed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.

### **3.03 CONTROL DAMPERS**

- A. All control dampers furnished by the control manufacturer are to be installed by the Contractor under the coordinating control and supervision of the Temperature Control Contractor in locations shown on plans or where required to provide specified sequence of control.
- B. Coordinate installation with the sheetmetal installer to obtain smooth duct transitions where damper size is different than duct size. Blank off plates will not be accepted. Transitions required to facilitate dampers shall be provided by Contractor.
- C. Each operator shall serve a maximum damper area of 36 square feet. Where larger dampers are used, provide multiple operators.
- D. Furnish control dampers as shown on drawings and/or as required to perform control sequences specified, except those furnished with other equipment.
- E. Control dampers furnished by Temperature Control Contractor shall be installed by Contractor under coordinating control and supervision of Temperature Control Contractor.

### **3.04 ROOM THERMOSTATS AND TEMPERATURE SENSORS**

- A. Check and verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate room thermostats and sensors 48 inches above floor. Align with light switches and humidistats. For drywall installations, thermostat mounting shall use a back-box attached to a wall stud, drywall anchors are not acceptable.
- B. Any room thermostats or sensors mounted on an exterior wall shall be mounted on a thermally insulated sub-base. Subbase to provide a minimum of one half inch of insulation.
- C. Where thermostats or sensors are mounted on exterior walls or in any location where air transfer will affect the measured temperature or humidity seal the conduit and any other opening that will affect the measurement.
- D. Provide guards on thermostats in entrance hallways, other public areas, or in locations where thermostat is subject to physical damage.

### **3.05 CURRENT STATUS SWITCHES**

- A. Provide for each fan specified or shown on control diagrams on drawings. Set threshold adjustment to indicate belt or coupling loss. Readjust threshold for proper operation after final balancing is completed.

### **3.06 TRAINING**

- A. See Section 23 05 00 – Common Work Results for HVAC for general training requirements.
- B. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 4 hours.
- C. Provide one training session per shift of building operating engineers at two times:
  - 1. At the start of the warranty period.

END OF SECTION

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**SECTION 23 11 00  
FACILITY FUEL PIPING**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Unless otherwise noted Contractor to provide fuel piping as specified and indicated on the drawings.

**1.02 SECTION INCLUDES**

- A. This section contains specifications for fuel pipe and fuel pipe fittings for this project. Included are the following topics:
  - 1. Natural Gas
  - 2. Vents and Relief Valves
  - 3. Unions and Flanges
  - 4. Valves
  - 5. Piping System Leak Tests

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 23 05 23 – General-Duty Valves for HVAC Piping
- C. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment

**1.04 SUBMITTALS**

- A. Refer to Section 23 05 00 – Common Work Results for HVAC, Submittals. In addition to the general content specified under Section 23 05 00 – Common Work Results for HVAC, supply the following submittals:
  - 1. Natural Gas
  - 2. Vents and Relief Valves
  - 3. Unions and Flanges
  - 4. Valves
  - 5. Piping System Leak Tests
- B. Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.
- C. Type E Or S Steel Pipe: Mill certification papers, also known as material test reports, for the pipe furnished for this project, in English. Heat numbers on these papers to match the heat numbers stenciled on the pipe. Chemical analysis indicated on the mill certification papers to meet or exceed the requirements of the referenced ASTM specification.

**1.05 REFERENCE STANDARDS**

- A. ANSI B16.3 Malleable Iron Threaded Fittings
- B. ASME (BPV) Boiler and Pressure Vessel Code; The American Society of Mechanical Engineers; 2007.
- C. ASME (BPV IX) Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers ; 2010.
- D. ASME B16.3 Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).
- E. ASME B16.18 Cast Copper Alloy Solder-Joint Pressure Fittings; The American Society of Mechanical Engineers ; 2001 (R2005) (ANSI B16.18).
- F. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers ; 2001 (R2005).
- G. ASME B16.26 Cast Copper Alloy Fittings for Flared Copper Tubes; The American Society of Mechanical Engineers ; 2006.
- H. ASME B31.1 Power Piping; The American Society of Mechanical Engineers ; 2007 (ANSI/ASME B31.1).

- I. ASME B36.10M Welded and Seamless Wrought Steel Pipe; The American Society of Mechanical Engineers ; 2004.
- J. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless ; 2010.
- K. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products ; 2009.
- L. ASTM A234/A234M Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service ; 2011.
- M. ASTM B32 Standard Specification for Solder Metal ; 2008.
- N. AWS A5.8/A5.8M Specification for Filler Metals for Brazing and Braze Welding; American Welding Society ; 2004 and errata.
- O. MSS SP-58 Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. ; 2009.
- P. MSS SP-80 Bronze Gate, Globe, Angle and Check Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. ; 2008.
- Q. MSS SP-110 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. ; 1996.
- R. NACE SP0169 Control of External Corrosion on Underground or Submerged Metallic Piping Systems; NACE International ; 2007.
- S. NFPA 30 Flammable and Combustible Liquids Code; National Fire Protection Association ; 2008.

#### **1.06 QUALITY ASSURANCE**

- A. Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM specification.
- B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

#### **1.07 DESIGN CRITERIA**

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.
- C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in occupied spaces and ventilation plenum spaces, including plenum ceilings.
- D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.
- B. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

#### **1.09 WELDER QUALIFICATIONS**

- A. Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code and/or the National Certified Pipe Welding Bureau.

- B. Before any polyethylene fusion welding is performed, Contractor to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.
- C. The A/E or owner reserves the right to test the work of any welder employed on the project, at the Contractor's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

#### **1.10 NATURAL GAS SERVICE**

- A. All charges for the gas service as shown on the plans, including the connection from the main in the street or other location to the gas meter, shall be paid by this Contractor, including setting of gas meter(s) and all work performed by the gas company.

### **PART 2 - PRODUCTS**

#### **2.01 NATURAL GAS**

- A. 2" and Smaller: ASTM A53, type E or S, standard weight (schedule 40) black steel pipe with ASTM A197/ANSI B16.3 class 150 black malleable iron threaded fittings or ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.
- B. 2-1/2" and Larger: ASTM A53, type E or S, standard weight black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.

#### **2.02 VENTS AND RELIEF VALVES**

- A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

#### **2.03 UNIONS AND FLANGES**

- A. 2" and Smaller: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 psi. Copper tube: 250 psi bronze unions with brazed joints.
- B. 2-1/2" and Larger: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding and of a pressure class compatible with that specified for valves, piping specialties and fittings of the respective piping service. Flanges smaller than 2-1/2" may be used as needed for connecting to equipment and piping specialties. Use raised face flanges ANSI B16.5 for mating with other raised face flanges on equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment. Copper tube: 250 psi slip on bronze flanges; 1/16<sup>th</sup> inch thick preformed neoprene gaskets.

#### **2.04 VALVES**

- A. Refer to specification section 23 05 23 for General Duty Valves for HVAC.

### **PART 3 – EXECUTION**

#### **3.01 PREPARATION**

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

#### **3.02 ERECTION**

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

- C. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.
- D. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.
- E. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment
- F. Install all valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

### **3.03 WELDED PIPE JOINTS**

- A. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable.
- B. Electrodes shall be Lincoln, or approved equal, with coating and diameter as recommended by the manufacturer for the type and thickness of work being done.

### **3.04 THREADED PIPE JOINTS**

- A. Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

### **3.05 NATURAL GAS**

- A. Pitch horizontal piping down 1" in 60 feet in the direction of flow. Install a 4" minimum depth dirt leg at the bottom of each vertical run and at each appliance. When installing mains and branches, cap gas tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main.
- B. Do not install gas pipe in a ventilation air plenum.
- C. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least five feet above grade.
- D. Install a shut off valve at each appliance. Provide a valved connection at the main for equipment and appliances furnished by others.
- E. Piping through a roof shall be run through an approved roof penetration with flashing and counter flashing.
- F. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.
- G. Clean all welded piping before all regulators and control valves. Test by placing target cloth over piping and blow with compressed air. Clean piping until target cloth is clean and free of debris.

### **3.06 VENTS AND RELIEF VALVES**

- A. Install vent and relief valve discharge lines as indicated on the drawings, as detailed, and as specified for each specific valve or piping specialty item. In no event is a termination to occur less than six feet above a roof line.

### **3.07 UNIONS AND FLANGES**

- A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

### **3.08 PIPING SYSTEM LEAK TESTS**

- A. Verify that the piping system being tested is fully connected to all components and that all equipment is properly installed, wired, and ready for operation. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.
- B. Provide all piping, fittings, blind flanges, and equipment to perform the testing.
- C. Conduct pressure test with test medium of air or water unless specifically indicated. Minimum test time is indicated in the table below; additional time may be necessary to conduct an examination for

- leakage. Each test must be witnessed by the Owner's representative. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.
- D. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking. After testing is complete, slowly release the pressure in a safe manner.
  - E. Measure natural gas system test pressure with a water manometer or an equivalent device calibrated in increments not greater than 0.1 inch water column. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.
  - F. All-pressure-tests-are-to-be-documented-on-attached-form-included-in-this-specification.
  - G. On piping that cannot be tested because of connection to an active line, provide temporary blind flanges and hydrostatically test new section of piping. After completion of test, remove temporary flanges and make final connections to piping.

END OF SECTION

**PIPING SYSTEM TEST REPORT**

Date Submitted: \_\_\_\_\_

Project Name: \_\_\_\_\_

Location: \_\_\_\_\_

Project No: \_\_\_\_\_

Contractor: \_\_\_\_\_

- |                                      |  |                                    |
|--------------------------------------|--|------------------------------------|
| <input type="checkbox"/> HVAC        | <input type="checkbox"/> Refrigeration | <input type="checkbox"/> Controls  |
| <input type="checkbox"/> Power Plant | <input type="checkbox"/> Plumbing      | <input type="checkbox"/> Sprinkler |

Test Medium:    Air                       Water                       Other \_\_\_\_\_

Test performed per specification section No. \_\_\_\_\_

Specified Test Duration \_\_\_\_\_ Hours                      Specified Test Pressure \_\_\_\_\_ PSIG

System Identification: \_\_\_\_\_

Describe Location: \_\_\_\_\_

Test Date: \_\_\_\_\_

Start Test Time: \_\_\_\_\_                      Initial Pressure: \_\_\_\_\_ PSIG

Stop Test Time: \_\_\_\_\_                      Final Pressure: \_\_\_\_\_ PSIG

Tested By: \_\_\_\_\_                      Witnessed By: \_\_\_\_\_

Title: \_\_\_\_\_                      Title: \_\_\_\_\_

Signed: \_\_\_\_\_                      Signed: \_\_\_\_\_

Date: \_\_\_\_\_                      Date: \_\_\_\_\_

Comments: \_\_\_\_\_

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

**SECTION 23 31 00  
HVAC DUCTS AND CASINGS**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Unless noted otherwise, the Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes specifications for all duct systems used on this project. Included are the following topics:
  - 1. Low Pressure Ductwork (Maximum 2 inch pressure class)
  - 2. Kitchen Hood Exhaust Duct Construction
  - 3. Dishwasher Exhaust Duct Construction
  - 4. Duct Sealant
  - 5. Gaskets

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this Section.
- B. Section 23 05 00 – Common Work Results for HVAC
- C. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- D. Section 23 33 00 – Air Duct Accessories

**1.04 SUBMITTALS**

- A. Refer to Section 23 05 00 – Common Work Results for HVAC, Submittals. In addition to the general content specified under Section 20 05 00 – Common Work Results for HVAC, supply the following submittals:
  - 1. Low Pressure Ductwork (Maximum 2 inch pressure class)
  - 2. Kitchen Hood Exhaust Duct Construction
  - 3. Dishwasher Exhaust Duct Construction
  - 4. Duct Sealant
  - 5. Gaskets
- B. Include manufacturer's data and/or Contractor data for the following:
- C. Fabrication and installation drawings.
  - 1. Schedule of duct systems including material of construction, gauge, pressure class, system class, method of reinforcement, joint construction, fitting construction, and support methods, all with details as appropriate.
  - 2. Duct sealant and gasket material.

**1.05 REFERENCE STANDARDS**

- A. ANSI SS-EN 485-2 Aluminum and Aluminum Alloys-Sheet, Strip and Plate-Part 2: Mechanical Properties
- B. ASTM B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- C. ASTM A90 Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
- D. ASTM A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- E. ASTM A623 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
- F. ASTM A527 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
- G. ASTM 924 Standard Specification for General Requirements for Sheet Steel, Metallic-coated by the Hot-dip Method
- H. ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials

- I. ASTM C 1338 Test Method for Determining Fungal Resistance of Insulation Materials and Facings
- J. ASTM G 21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
- K. ASTM C 916 Standard Specification for Adhesives for Duct Thermal Insulation NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems
- L. UL 181 Standard for Safety for Factory Made Air Ducts and Air Connectors.

**1.06 QUALITY ASSURANCE**

- A. Refer to division 1 for equals and substitutions.

**1.07 DESIGN CRITERIA**

- A. Construct all ductwork to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions.
- B. Use material, weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA publications, unless noted otherwise:
  - 1. HVAC Duct Construction Standards, Metal and Flexible, 3<sup>rd</sup> Edition, 2005
  - 2. HVAC Air Duct Leakage Test Manual, 1<sup>st</sup> Edition, 1985
  - 3. HVAC Systems - Duct Design, 4<sup>th</sup> Edition, 2006
  - 4. Rectangular Industrial Duct Construction Standard, 2<sup>nd</sup> Edition, 2004
  - 5. Round Industrial Duct Construction Standards, 2<sup>nd</sup> Edition, 1999
- C. Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.

**1.08 DELIVERY, STORAGE AND HANDLING**

- A. Promptly inspect shipments to ensure that Ductwork is undamaged and complies with the specification.
- B. Protect Ductwork against damage.
- C. Protect Ductwork by storing inside or by durable, waterproof, above ground packaging. Do not store material on grade. Protect Ductwork from dirt, dust, construction debris and foreign material. Where end caps/packaging are provided, take precautions so caps/packaging remain in place and free from damage.
- D. Offsite storage agreements do not relieve the contractor from using proper storage techniques.
- E. Storage and protection methods must allow inspection to verify products.

**PART 2 – PRODUCTS**

**2.01 GENERAL**

- A. All sheet metal used for construction of duct shall be 24 gauge or heavier except for round and spiral ductwork and spiral duct take-offs 12” and below may be 26 gauge where allowed in SMACNA HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005.
- B. Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net, inside of liner.

**2.02 DUCTWORK PRESSURE CLASS**

- A. Minimum acceptable SMACNA duct pressure class, for all ductwork except transfer ductwork, is 2 inch W.G. positive or negative, depending on the application. Transfer ductwork minimum acceptable duct pressure class is 1 inch W.G. positive or negative, depending on the application. Duct system pressure classes not indicated on the drawings to be as follows:
 

Transfer ducts	1 in. pressure class
Low pressure exhaust ducts	2 in. negative pressure class
Relief ducts	3 in. pressure class
Outside air duct systems	1 in. negative pressure class
Grease exhaust systems	2 in. negative pressure class



### **2.03 MATERIALS**

- A. Galvanized Steel Sheet: Use ASTM A 653 galvanized steel sheet of lock forming quality. Galvanized coating to be 1.25 ounces per square foot, both sides of sheet, G90 in accordance with ASTM A90. Provide "Paint Grip" finish or galvaneal sheetmetal for ductwork that will be painted.
- B. Uncoated Black Steel Sheet: First quality, soft steel sheet capable of welding or double seaming without fracture.
- C. Aluminum Sheet: Use ANSI/ASTM B209 aluminum sheet, alloy 3003H-14, capable of double seaming without fracture.
- D. Stainless Steel Sheet: Use ASTM A167, Type 304 or 316 stainless steel sheet as specified, 316L if welded ductwork, with No. 2B finish for concealed work and No. 3 finish for exposed work.
- E. Prefabricated Grease Ducts: Dual wall construction with stainless steel inner liner, insulation and stainless steel (for exposed locations) or aluminized steel (for concealed locations) shell. Furnish all items which form a part of the assembly, including, tee sections, straight sections, elbows, end caps, cleanouts, expansion joints, fan/hood transitions, supports, flashing, counter flashing, and insulated roof thimble where required. Each section shall bear the factory applied Underwriters Laboratories Label.

### **2.04 LOW PRESSURE DUCTWORK (MAXIMUM 2 INCH PRESSURE CLASS)**

- A. Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as modified below.
- B. Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction when fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if the screw does not extend more than 1/2 inch into the duct.
- C. Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits. When a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes in accordance with SMACNA publications, Type RE 3. Where space will not allow and the C value of the radius elbow, as given in SMACNA publications, exceeds 0.31, use rectangular elbows with turning vanes as specified in Section 23 33 00 – Air Duct Accessories. Square throat-radius heel elbows will not be acceptable. Straight taps or bullhead tees are not acceptable.
- D. Where rectangular elbows are used, provide turning vanes in accordance with Section 23 33 00 – Air Duct Accessories.
- E. Provide expanded take-offs or 45 degree entry fittings for branch duct connections with branch ductwork airflow velocities greater than 700 fpm. Square edge 90-degree take-off fittings or straight taps will not be accepted.
- F. Button punch snaplock construction will not be accepted on aluminum ductwork.
- G. No variation of duct configuration or sizes permitted except by written permission of the Architect/Engineer. Substitution of round ducts for rectangular ducts will only be considered if sized in accordance with ASHRAE table of equivalent rectangular and round ducts.
- H. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- I. Transverse joints for rectangular ducts shall be in accordance with SMACNA HVAC Duct Construction Standards type T-15 through T-24.
- J. Button punch snap lock (SMACNA L-2) and grooved seams (SMACNA L-3) shall not be used on rectangular duct longitudinal seams.
- K. Longitudinal seams for round ducts shall be lock type spiral seam (SMACNA RL-1) or grooved seam (SMACNA RL-5).
- L. Snaplock seams are acceptable on low pressure round ducts with a diameter of 12" or less.

### **2.05 KITCHEN HOOD EXHAUST DUCT CONSTRUCTION**

- A. In concealed locations use minimum 16 gauge black steel or minimum 18 gauge stainless steel with all joints welded liquid tight or prefabricated grease duct, Underwriters Laboratory, Inc. listed with aluminized steel shell

- B. In exposed areas, use 18 gauge or heavier stainless steel with a number 3 finish and 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.
- C. Provide expanded take-offs for branch duct connections or 45 degree entry fittings. Square edge 90 degree take-off fittings or straight taps will not be accepted.
- D. Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits shall be used wherever possible. Shorter radius elbows may be used in areas with limited space with prior approval of the Architect/Engineer.
- E. No turning vanes may be used in kitchen exhaust duct.
- F. Supporting steel and hangers shall not be lighter than the duct gauge.

## **2.06 DISHWASHER EXHAUST DUCT CONSTRUCTION**

- A. Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as indicated below.
- B. Use 18 gauge or heavier stainless steel with all seams and joints welded and ground smooth. In exposed areas, joints and seams to be polished to a #3 finish (minimum).
- C. Use elbows and tees as specified for the appropriate duct pressure class.
- D. Provide expanded take-offs for branch duct connections or 45 degree entry fittings. Square edge 90 degree take-off fittings or straight taps will not be accepted.

## **2.07 DUCT SEALANT**

- A. Manufacturer: 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Hardcast Peal & Seal, Lockformer cold sealant, Mon-Eco Industries, United Sheet Metal. Silicone sealants are not allowed in any type of ductwork installation.
- B. Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup of air handling systems.
- C. For plenums installations, use duct sealant with a flame spread index of not more than 25 and smoke-developed index of not more than 50. When tested in accordance with ASTM E84 or UL 723.

## **2.08 GASKETS**

- A. 2 Inch Pressure Class and Lower: Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.

# **PART 3 – EXECUTION**

## **3.01 INSTALLATION**

- A. Verify dimensions at the site, making field measurements and drawings necessary for fabrication and erection. Check plans showing work of other trades and consult with Architect in the event of any interference.
- B. Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Transform, divide or offset ducts as required, in accordance with SMACNA HVAC Duct Construction Standards, Figure 4-7, except do not reduce duct to less than six inches in any dimension and do not exceed an 8:1 aspect ratio. Where it is necessary to take pipes or similar obstructions through ducts, construct easement as indicated in SMACNA HVAC Duct Construction Standards, Figure 4-8, Fig. E. In all cases, seal to prevent air leakage. Pipes or similar obstructions may not pass through high pressure ductwork, fume exhaust ductwork or kitchen hood exhaust ductwork.
- C. Test openings for test and balance work will be provided under Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.
- D. Provide frames constructed of angles or channels for coils, filters, dampers or other devices installed in duct systems, and make all connections to such equipment including equipment furnished by others. Secure frames with gaskets and screws or nut, bolts and washers.
- E. Install duct to pitch toward outside air intakes and drain to outside of building. Solder or seal seams to form watertight joints.

- F. Where two different metal ducts meet, the joint shall be installed in such a manner that metal ducts do not contact each other by using proper seal or compound.
- G. Install all motor operated dampers and connect to or install all equipment furnished by others. Blank off all unused portions of louvers, as indicated on the drawings, with 1-1/2 inch board insulation with galvanized sheet metal backing on both sides.
- H. Do not install ductwork through dedicated electrical rooms or spaces unless the ductwork is serving this room or space.
- I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- J. Provide adequate access to ductwork for cleaning purposes.
- K. Provide temporary capping of ductwork openings on job site, both before and after installation, to prevent entry of dirt, dust and foreign material.
- L. Protect diffusers, registers and grilles with plastic wrap or some other approved form of protection to maintain dirt and dust free and to prevent entry of dirt, dust and foreign material into the ductwork.
- M. Install prefabricated grease ductwork assemblies in accordance with manufacturer requirements and NFPA 96.
- N. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- O. All ductwork not welded, at a minimum, shall be sealed using duct sealant or gaskets on all seams, joints and penetrations.
- P. Provide 45 degree entry fitting with a minimum throat length of 25% of the width of the branch duct takeoff or 4 inches, whichever is larger.

### **3.02 DUCTWORK SUPPORT**

- A. Support ductwork in accordance with the latest SMACNA HVAC Duct Construction Standards, Figure 5-5, except supporting ductwork with secure wire method is not allowed.
- B. Support with 3/32 inch, 7 x 7, stainless steel air-craft cable, with matching fastener rated for 50% of actual load, will be allowed on round ductwork under 12 inches if installed as detailed, with cable double looped on duct and at point of support.
- C. On ductwork sections exceeding 8', provide at least two supports.

### **3.03 LOW PRESSURE DUCT (MAXIMUM 2 INCH PRESSURE CLASS)**

- A. Seal all duct, with the exception of transfer ducts, in accordance with SMACNA seal class "A". All seams, joints, and penetrations shall be sealed using duct sealant or gaskets per Part 2 - Products.
- B. Install a manual balancing damper in each branch duct and for each diffuser or grille. The use of splitter dampers, extractors, or grille face dampers will not be accepted for balancing dampers.
- C. Hangers must be wrapped around bottom edge of duct and securely fastened to duct with sheetmetal screws or pop rivets. Trapeze hangers may be used at contractor's option.

### **3.04 KITCHEN HOOD EXHAUST DUCT CONSTRUCTION**

- A. Where welded joints are used with black steel duct, coat all external welded joints and seams with paint. Grind and polish to #3 finish all exposed stainless steel joints and seams.
- B. Apply bracing and reinforcement to the outside of the duct to prevent breathing, rattling, vibration or sagging of duct.
- C. Install without forming dips, sag or 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.
- D. Construct grease tight access doors of the same material and thickness as the duct and as large as possible, up to 24 inches in any dimension. Provide access doors in the ductwork per NFPA 96 at max 10' intervals and at all changes in direction.
- E. Insulation or fire protection enclosure shall be removable at each access door and clean out.
- F. Pitch horizontal ducts back to hood at 1 inch per foot or at least greater than code minimum of 1/4" per foot on ducts less than 50 feet lengths.

### **3.05 DISHWASHER EXHAUST DUCT CONSTRUCTION**

- A. Pitch duct to drain back to equipment.
- B. Provide water tight drain pan at low points or at locations where moisture may collect. Pipe drain pan to nearest floor drain.

### **3.06 CLEANING**

- A. Remove all dirt and foreign matter from the entire duct system and clean diffusers, registers, grilles and the inside of air-handling units before operating fans.
- B. Clean duct systems with high power vacuum machines where systems have been used for temporary heat, air-conditioning, or ventilation purposes during construction. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning.

### **3.07 LEAKAGE TEST**

- A. Test all ductwork in accordance with test methods described in Section 5 of SMACNA HVAC Air Duct Leakage Test Manual. Do not insulate ductwork until it has been successfully tested. Test pressure shall be equal to the duct pressure class.
- B. If excessive air leakage is found locate leaks, repair the duct in the area of the leak, seal the duct, and retest.
- C. Leakage rate shall not exceed more than 5% of the system air quantity for low pressure ductwork, determined in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.
- D. Leakage rate shall not exceed more than 1% of the system air quantity for high pressure ductwork, determined in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.
- E. Leakage test for ductwork downstream of air terminal devices may be omitted but will not relieve the contractor from duct sealing requirements.
- F. Submit a signed report to the Owner, indicating test apparatus used, results of the leakage test, and any remedial work required to bring duct systems into compliance with specified leakage rates.

### **3.08 STRUCTURAL TEST**

- A. Random test all ductwork per owner's direction. Do not insulate ductwork until it has been successfully tested.
- B. Deflection limits shall not exceed those listed in accordance with Chapter 11 of SMACNA HVAC Duct Construction Standards, 3.0 Performance Requirements.
- C. Submit a signed report to the Owner, indicating test apparatus used, results of the structural test, and any remedial work required.

END OF SECTION

## DUCT LEAKAGE TEST REPORT

**Project Number:** \_\_\_\_\_  
**Date Submitted:** \_\_\_\_\_  
**Project Name:** \_\_\_\_\_  
**Location:** \_\_\_\_\_  
**Contractor:** \_\_\_\_\_  
**System:** Fan No.: \_\_\_\_\_ Leakage Class (C<sub>L</sub>): \_\_\_\_\_  
**Data:** Fan Design CFM: \_\_\_\_\_ Duct Pressure Class (P<sub>c</sub>): \_\_\_\_\_  
 Test Pressure (P<sub>T</sub>): \_\_\_\_\_  
**Test Equipment:** Manufacturer: \_\_\_\_\_  
**Model No.:** \_\_\_\_\_ **Serial No.:** \_\_\_\_\_

For large systems, use the reverse side for a simple sketch of the entire duct system. Then use letter designations to indicate the various duct sections being tested at one time. Also use the reverse side for test comments.

Note that due to normal construction sequencing it is usually necessary to test risers separately prior to enclosing chases.

Design Data								Field Test Data				
Duct Section	Duct Shape	Duct Surface (Ft <sup>2</sup> )	Allowable Leakage		Diameter		Pressure (in. wc.)		Date	Performed By	Observed By	Actual CFM
			Leakage Factor (P <sup>.65</sup> C <sub>L</sub> )	CFM for Section			In Duct (P)	Across Orifice (P <sub>drop</sub> )				
					Tube (D <sub>1</sub> )	Orifice (D <sub>2</sub> )						
<b>TOTAL</b>												

## DUCT STRUCTURAL TEST REPORT

**Project Number:** \_\_\_\_\_

**Date Submitted:** \_\_\_\_\_

**Project Name:** \_\_\_\_\_

**Location:** \_\_\_\_\_

**Contractor:** \_\_\_\_\_

**System: Fan No.:** \_\_\_\_\_

**Description of Test Method:** \_\_\_\_\_

\_\_\_\_\_

**Test Equipment: Manufacturer:** \_\_\_\_\_

**Model No.:** \_\_\_\_\_ **Serial No.:** \_\_\_\_\_

For large systems, use the reverse side for a simple sketch of the entire duct system. Then use letter designations to indicate the various duct sections being tested at one time. Also use the reverse side for test comments.

Note that due to normal construction sequencing it is usually necessary to test risers separately prior to enclosing chases.

Design Data									Field Test Data					
Duct Test Location	Ductwork Shape		Duct Pressure Class	Allowable Ductwork Wall Deflection		Allowable Joint/Reinforcement Deflection		Pressure (in. wc.) In Duct	Measured Ductwork Wall Deflection		Measured Joint/Reinforcement Deflection		Performed By/Date	Witnessed By/Date
	H	W		H	W	H	W		H	W	H	W		

**SECTION 23 33 00**  
**AIR DUCT ACCESSORIES**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Unless noted otherwise, the Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes accessories used in the installation of duct systems. Included are the following topics:
  - 1. Manual Volume Dampers
  - 2. Control Dampers
  - 3. Access Doors
  - 4. Flashings
  - 5. Louvers

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this Section.
- B. Section 23 05 00 – Common Work Results for HVAC
- C. Section 23 05 29 – Hanger and Supports for HVAC Piping and Equipment
- D. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
- E. Section 23 31 00 – HVAC Ducts and Casings

**1.04 SUBMITTALS**

- A. Refer to Section 23 05 00 – Common Work Results for HVAC, Submittals. In addition to the general content specified under Section 20 05 00 – Common Work Results for HVAC, supply the following submittals:
  - 1. Manual Volume Dampers
  - 2. Control Dampers
  - 3. Smoke Detectors
  - 4. Access Doors
  - 5. Flashings
  - 6. Louvers
- B. Submit for all accessories and include dimensions, capacities, ratings, installation instructions, and appropriate identification.
- C. Include certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance of sound attenuators.
- D. Submit manufacturer's color charts where finish color is specified to be selected by the Architect/Engineer.

**1.05 REFERENCE STANDARDS**

- A. NAIMA Fibrous Glass Duct Liner Standard
- B. NFPA 90A Standard for Installation of Air Conditioning and Ventilating Systems
- C. SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition, 1995
- D. UL 214
- E. UL 555 (6<sup>th</sup> edition) Standard for Fire Dampers and Ceiling Dampers
- F. UL 555S (4<sup>th</sup> edition) Leakage Rated Dampers for Use in Smoke Control Systems

**1.06 QUALITY ASSURANCE**

- A. Refer to Division 1 for equals and substitutions

### **1.07 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified in Section 23 05 00 - Common Work Results for HVAC.

## **PART 2 – PRODUCTS**

### **2.01 MANUAL VOLUME DAMPERS**

- A. Manufacturers: Ruskin, Vent Products, Air Balance.
- B. Dampers must be constructed in accordance with SMACNA Fig. 2-12, Fig. 2-13, and notes relating to these figures, except as modified below.
- C. Reinforce all blades to prevent vibration, flutter, or other noise. Construct dampers in multiple sections with mullions where width is over 48 inches. Use rivets or tack welds to secure individual components; sheet metal screws will not be accepted. Provide operators with locking devices and damper position indicators for each damper; use an elevated platform on insulated ducts. Provide end bearings or bushings for all volume damper rods penetrating ductwork constructed to a 3" w.c. pressure class or above.

### **2.02 CONTROL DAMPERS**

- A. Control dampers are specified in section 23 09 14.

### **2.03 ACCESS DOORS**

- A. Access door to be designed and constructed for the pressure class of the duct in which the door is to be installed. Doors in exposed areas shall be hinged type with cam sash lock. Hinges shall be steel full length continuous piano type. Doors in concealed spaces may be secured in place with cam sash latches. For both hinged and non-hinged doors provide sufficient number of cam sash latches to provide air tight seal when door is closed. Do not use hinged doors in concealed spaces if this will restrict access. Use minimum 1" deep 24 gauge galvanized steel double wall access doors with minimum 24 gauge galvanized steel frames. For non-galvanized ductwork, use minimum 1" deep double wall access door with frame that shall use materials of construction identical to adjacent ductwork. Provide double neoprene gasket that shall provide seals from the frame to the door and frame to the duct. When access doors are installed in insulated ductwork or equipment provide insulated doors with insulation equivalent to what is provided for adjacent ductwork or equipment. Access doors constructed with sheet metal screw fasteners will not be accepted.
- B. Use insulated 1-1/2 hour UL 1978 listed and labeled access doors in kitchen exhaust ducts.

### **2.04 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.

### **2.05 LOUVERS**

- A. Louvers are specified in the architectural section of these specifications.

## **PART 3 – EXECUTION**

### **3.01 MANUAL VOLUME DAMPERS**

- A. Install manual volume dampers in each branch duct and for each grille, register, or diffuser as far away from the outlet as possible while still maintaining accessibility to the damper. Install so there is no flutter or vibration of the damper blade(s).

### **3.02 CONTROL DAMPERS**

- A. Install dampers in locations indicated on the drawings, as detailed, and according to the manufacturer's instructions. Install blank-off plates or transitions where required for proper mixing of airstreams in



mixing plenums. Provide adequate operating clearance and access to the operator. Install an access door adjacent to each control damper for inspection and maintenance.

**3.03 ACCESS DOORS**

- A. Install access doors where specified, indicated on the drawings, and in locations where maintenance, service, cleaning or inspection is required. Examples include, but are not limited to motorized dampers, fire and smoke dampers, smoke detectors, fan bearings, heating and cooling coils, filters, valves, and control devices needing periodic maintenance.
- B. Size and numbers of duct access doors to be sufficient to perform the intended service. Minimum access door size shall be 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, or other size as indicated.

**3.04 FLASHINGS**

- A. Flashing for roof curbs, equipment supports or rails located on roof will be installed by others.

**3.05 LOUVERS**

- A. Louvers are furnished and installed by GC.
- B. Provide bird screen where none is provided with louvers. Where louvers are equipped with inside bird screen, remove screen at all locations where duct connections are not made.

**3.06 TRAINING**

- A. See Section 23 05 00 – Common Work Results for HVAC for general training requirements.
- B. In addition to the training provided in Section 23 05 00 – Common Work Results for HVAC, provide an additional 1 hours of training for each type of duct accessory provided on the project.

END OF SECTION

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**SECTION 23 34 00**  
**HVAC FANS**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Unless noted otherwise, the Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes specifications for fans that are not an integral part of a manufactured device. Included are the following topics:
  - 1. Centrifugal Fans
  - 2. In-line Centrifugal Fans
  - 3. Power Roof Exhaust Fans
  - 4. Ceiling Exhaust Fans

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this Section.
- B. Section 23 05 00 – Common Work Results for HVAC
- C. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
- D. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- E. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment

**1.04 SUBMITTALS**

- A. Refer to Section 23 05 00 – Common Work Results for HVAC, Submittals. In addition to the general content specified under Section 20 05 00 – Common Work Results for HVAC, supply the following submittals:
  - 1. Centrifugal Fans
  - 2. In-line Centrifugal Fans
  - 3. Power Roof Exhaust Fans
  - 4. Ceiling Exhaust Fans
- B. Include dimensions, capacities, fan curves, materials of construction, ratings, weights, motors and drives, sound power levels, appropriate identification and vibration isolation for all equipment. Sound power levels to be based on tests performed in accordance with AMCA Standard 300.
- C. Submit color selection charts for equipment where applicable.
- D. Fan curves shall indicate the relationship of CFM to static or total pressure for various fan speeds. Maximum and minimum RPM curves shall be displayed on fan curve. Brake horsepower, recommended selection range, and limits of operation are to also be indicated on the curves. Indicate operating point on the fan curves at design air quantity and indicate the manufacturer's recommended drive loss factor for the specific application. Tabular fan performance data is not acceptable.
- E. For variable air volume application, include data which indicates the effect of capacity control devices, such as inlet vanes, on performance.

**1.05 REFERENCE STANDARDS**

- A. AMCA 203 AMCA Fan Application Manual - Troubleshooting
- B. AMCA 210 Laboratory Method of Testing Fans for Rating
- C. AMCA 300 Reverberant Room Method for Sound Testing of Fans
- D. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems
- E. NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
- F. UL 762 Power Roof Ventilators For Restaurant Exhaust Appliances

**1.06 QUALITY ASSURANCE**

- A. Refer to Division 1 for equals and substitutions.

### **1.07 DESIGN CRITERIA**

- A. Tested and certify all fans in accordance with the applicable AMCA test code.
- B. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.
- C. Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA Publication 203, Appendix L.
- D. Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, provide any motor, drive and/or wiring changes required due to increased static pressure or baffling necessary to prevent uneven airflow or improve mixing.
- E. All internal insulation and other components exposed to the airstream are to meet the flame spread and smoke ratings contained in NFPA 90A.
- F. All roof mounted equipment to be provided with curbs or equipment stands in accordance with specification in Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

### **1.08 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified in Section 23 05 00 – Common Work Results for HVAC.

## **PART 2 – PRODUCTS**

### **2.01 GENERAL**

- A. Use fan size, class, type, arrangement, and capacity as scheduled.
- B. Furnish complete with motors, wheels, drive assemblies, bearings, vibration isolation devices, and accessories required for specified performance and proper operation. All single phase motors to have inherent thermal overload protection.
- C. Provide variable pitch sheaves for drives 3 hp and smaller, fixed pitch sheaves for drives 5 hp and larger. Design all drives for 150% of motor rating.
- D. Use OSHA approved belt guards that totally enclose the entire drive. Construct guards of expanded metal to allow for ventilation; provide tachometer openings at shaft locations.
- E. Statically and dynamically balance all fans so they operate without objectionable noise or vibration.
- F. All fans handling grease laden vapors shall meet the requirements of UL 762 and NFPA 96.

### **2.02 CENTRIFUGAL FANS**

- A. Manufacturers: PennBarry, Peerless, Buffalo, Carrier, Champion, Chicago Blower, Greenheck, New York Blower, Trane, Twin City, Cook.
- B. Construct housing of welded steel with angle iron frame. Use spun or die formed inlet cones to provide a streamlined flow into the wheel. Use airfoil blades welded to spun wheel cones unless otherwise indicated. Shafts shall be AISI C 1045 hot rolled steel turned, ground and polished. Shaft shall be sized for at least 125% of the fans maximum cataloged RPM.
- C. Bearings to be self-aligning grease packed pillow block type with grease seal and external grease fittings with a minimum L50 life of 200,000 hours at the maximum cataloged operating speed. Provide each fan housing with a capped drain connection and bolted and gasketed access door for inspection of fan wheel. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation; apply a second coat of paint to all exterior surfaces.
- D. Fans shall bear the AMCA Certified Ratings Seal for Sound and Air Performance.
- E. Provide one inch galvanized mesh inlet screens for fans without inlet ductwork.

### **2.03 IN-LINE CENTRIFUGAL FANS**

- A. Manufacturers: Acme, PennBarry, Cook, Greenheck, New York Blower, Peerless, Penn, Twin City.
- B. Construct housing of welded steel with reinforcing to prevent distortion. Furnish with streamlined inlet cones and multiple straightening vanes following the fan wheel to minimize noise and reduce turbulence. Provide each housing with a bolted and gasketed access door for inspection of drive and fan wheel. Use non-overloading airfoil blade fans welded to the wheel cones. Isolate belt drives from airstream with a belt tube. Externally mount motors on an adjustable base. Bearings to be grease

lubricated, self-aligning ball bearing type with grease seal and external grease fitting. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all exterior surfaces.

- C. Design all vertically mounted fans to withstand the vertical thrust loads.
- D. Provide variable inlet vanes for fans as scheduled. Vane bearings shall have grease fittings extended to an accessible location.
- E. Provide one inch galvanized mesh inlet screens for fans without inlet ductwork.

#### **2.04 POWER ROOF EXHAUST FANS**

- A. Manufacturers: Carnes, Greenheck, Penn, Jenn-Air, Cook, ACME.
- B. Provide upblast or downblast units, as scheduled, with aluminum housing, non-overloading type centrifugal wheel, inlet cone, factory mounted and wired motor and disconnect switch, and bird screen.
- C. Electrical Contractor will provide disconnect switches and thermal overload protection for units with three phase motors.
- D. Upblast units to have motor, bearings, and drives completely enclosed and isolated from the exhaust air stream with ventilation provided by outside air. Units handling grease laden vapors to be U.L. listed for conveying such vapors, operating continuously at 300 degrees F.
- E. See Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment for roof curb information.

#### **2.05 CEILING EXHAUST FANS**

- A. Carnes, Greenheck, Penn, Jenn-Air, Cook, ACME, Accurex.
- B. Centrifugal blower wheel, steel housing with acoustical lining, integral exhaust grille, adjustable mounting brackets to allow for any ceiling thickness, permanently lubricated motor, integral junction box with permanently lubricated and thermally protected motor factory wired, 24 volt electrically operated control damper with blade edge and jamb seals, and damper operator.
- C. Provide wall, eave, or roof discharge assembly, as indicated on the drawings.

### **PART 3 – EXECUTION**

#### **3.01 INSTALLATION**

- A. Install as shown on the drawings, as detailed, and according to manufacturer's installation instructions. On units provided with a drain connection, reduce drain connection down to ½" fitting and leave open.
- B. Install thrust restraints in accordance with the requirements of Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

#### **3.02 TRAINING**

- A. See Section 23 05 00 – Common Work Results for HVAC for general training requirements.
- B. In addition to the training provided in Section 23 05 00, provide an additional 1 hour of training for each type of fan provided on the project.

END OF SECTION

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**SECTION 23 37 13**  
**DIFFUSERS, REGISTERS & GRILLES**

**PART 1 - GENERAL**

**1.01 SCOPE OF WORK**

- A. Unless noted otherwise, the Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes specifications for air terminal equipment. Included are the following topics:
  - 1. Heavy Duty Side-wall Return/Exhaust Grille
  - 2. Door Grille

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 23 05 00 – Common Work Results for HVAC
- C. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
- D. Section 23 31 00 – HVAC Ducts and Casings
- E. Section 23 33 00 – Air Duct Accessories

**1.04 SUBMITTALS**

- A. Refer to Section 23 05 00 – Common Work Results for HVAC, Submittals. In addition to the general content specified under Section 20 05 00 – Common Work Results for HVAC, supply the following submittals:
  - 1. Heavy Duty Side-wall Return/Exhaust Grille
  - 2. Door Grille
- B. Furnish submittal information including, but not limited to, the following:
  - 1. Manufacturer's name and model number
  - 2. Identification as referenced in the documents
  - 3. Capacities/ratings
  - 4. Materials of construction
  - 5. Sound ratings
  - 6. Dimensions
  - 7. Finish
  - 8. Color selection charts where applicable
  - 9. Manufacturer's installation instructions
  - 10. All other appropriate data

**1.05 REFERENCE STANDARDS**

- A. NFPA 90A Installation of Air Conditioning and Ventilation Systems.
- B. UL 181 Factory-Made Air Ducts and Connectors.
- C. ARI-ADC Standard 880

**1.06 QUALITY ASSURANCE**

- A. Refer to Division 1 for equals and substitutions.

**1.07 DESIGN CRITERIA**

- A. All performance data shall be based on tests conducted in accordance with Air Diffusion Council (ADC) Test Code 1062 GRD 84.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Manufacturers: Carnes, Krueger, Titus, Metal-Aire, and E.H. Price, and United Sheet Metal.
- B. Acceptable manufacturers for specific products are listed under each item.

### **2.02 HEAVY DUTY SIDE-WALL RETURN/EXHAUST GRILLE**

- A. Titus model 30, Carnes Sturdicore, Price 91, Metal Aire series SBG, Krueger series 480, Price model 91.
- B. Grille border 16-gauge steel and grille blades 14-gauge steel suitable for gymnasium applications.
- C. Fixed blade 45 degree.
- D. Grille sizes as shown on drawings and/or as scheduled.
- E. Refer to architectural plan for ceiling installation conditions types. It is the responsibility of the contractor to coordinate frame and border of diffusers with general contractor.
- F. White, baked enamel finish or powder coat finish, unless otherwise indicated.

### **2.03 DOOR GRILLE**

- A. Titus Series 700, Carnes Series RF or RG, Metal Aire Series DG, Price ATG/STG
- B. Aluminum. Sight tight.
- C. Grille sizes, frame types, and finishes as shown on drawings and/or as scheduled.
- D. White, baked enamel finish or powder coat finish, unless otherwise indicated.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install grilles, registers and diffusers as shown on drawings and according to manufacturer's instructions.
- B. Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar size.
- C. Seal connections between ductwork drops and diffusers/grilles airtight.
- D. Where diffusers, registers and grilles cannot be installed to avoid seeing inside duct, paint inside of duct with flat black paint to reduce visibility.

END OF SECTION



**SECTION 23 41 00  
PARTICULATE AIR FILTRATION**

**PART 1 - GENERAL**

**1.01 SCOPE OF WORK**

- A. Unless noted otherwise or referenced from another specification section by a different contractor, the Contractor shall provide all labor and materials for a complete system in this specification section.

**1.02 SECTION INCLUDES**

- A. This section includes specifications for air system filters. Included are the following topics:
  - 1. Panel Filters
  - 2. Housings for Panel Filters
  - 3. Filter Gauges

**1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 23 05 00 – Common Work Results for HVAC
- C. Section 23 07 00 – HVAC Insulation

**1.04 SUBMITTALS**

- A. Refer to Section 23 05 00 – Common Work Results for HVAC, Submittals. In addition to the general content specified under Section 20 05 00 – Common Work Results for HVAC, supply the following submittals:
  - 1. Panel Filters
  - 2. Housings for Panel Filters
  - 3. Filter Gauges
- B. Include data concerning dimensions, materials, efficiencies, installation instructions and appropriate identification.
- C. Independent test reports verifying filter performance, test procedures and ratings.

**1.05 REFERENCE STANDARDS**

- A. ASHRAE Standard 52
- B. UL 181 – Standard for Factory-Made Air Ducts and Air Connectors
- C. UL 586 – Standard for High Efficiency Particulate Air Filter Units
- D. UL 900 – Standard for Air Filter Units

**1.06 QUALITY ASSURANCE**

- A. Refer to Division 1 for equals and substitutions.

**1.07 DESIGN CRITERIA**

- A. Use UL Class 1 or Class 2 filters unless noted otherwise.(Reference applicable UL standard referenced)
- B. Efficiencies indicated in this section are based on ASHRAE Standard 52.
- C. Fan motors have been selected to operate against the resistance of dirty filters as specified in this section.

**1.08 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified in Section 23 05 00 – Common Work Results for HVAC.

## **PART 2 – PRODUCTS**

### **2.01 MANUFACTURERS**

- A. American Air Filter, Barnebey-Cheney, Cambridge, Continental, Flanders, Camil-Farr, Mine Safety Appliances, Research Products, BLC Industries.
- B. Provide fixed filter blockoffs as required to prevent air bypass around filters. Blockoffs shall not need to be removed during filter replacement.

### **2.02 PANEL FILTERS**

- A. Use 1" (or as scheduled) thick fiberglass blanket enclosed in a cardboard frame and reinforced with a perforated metal retainer on the air leaving side, 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.

### **2.03 HOUSINGS FOR PANEL FILTERS**

- A. Manufactured by filter media manufacturer or contractor fabricated. Casing and tracks constructed of galvanized or enameled steel or aluminum. Provide access to the media tracks from outside the casing so media and be readily changed.

### **2.04 FILTER GAUGES**

- A. Manufacturers: Dwyer.
- B. Each filter section shall be provided with a factory-installed, flush-mounted, direct reading Dwyer 3 1/2" type differential pressure gauge with metal case piped to both sides of the filter to indicate status. Gauge shall maintain a +/- 5% accuracy within operating temperature limits of -20° F to 120° F. Filter sections consisting of pre- and post-filters shall have a gauge for each. Lettering shall be black figures on white background. Provide front recalibration adjustment.
- C. Provide gauges with the following ranges:

<u>Filter Type</u>	<u>Scale Range (inch W.G.)</u>
Panel filters	0.0 to 0.5

- 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**

### **3.01 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.

### **3.02 FILTER GAUGES**

- A. Install filter gauge static pressure tips upstream and downstream of filters. Mount gauge on outside of filter housing or filter plenum in accessible position outside of the unit housing. Install tubing and gauge valves between gauge and sensor tips. Adjust and level each gauge.

**3.03 TRAINING**

- A. See Section 23 05 00 – Common Work Results for HVAC for general training requirements.
- B. In addition to the training provided in Section 23 05 00 – Common Work Results for HVAC, provide an additional 1 hours of training for each type of filter housing provided on the project.

END OF SECTION

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**SECTION 26 05 00  
COMMON WORK RESULTS FOR ELECTRICAL**

**PART 1 - GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: Electrical Contractor provide: It is the intent of these specifications to provide complete and workable electrical systems as shown on the accompanying plans and as specified herein except such parts as are specifically exempted herein. Provide all necessary supervision, coordination, labor, materials, equipment, fixtures, dryage, hoisting, tools, transportation, plant services and facilities, machinery and connections to utilities for the installation of complete and operable electrical systems. If details or special conditions are required in addition to those shown on drawings, provide all material and equipment usually furnished with such systems or required to complete their installation, whether noted in plans and specification or not.
- B. Materials and labor shall be new (unless noted otherwise), first class and workmanlike and shall be subject at all times to the A/E's inspections, tests and approval from the commencement until the acceptance of the completed work.
- C. The layout shown on the drawings is necessarily diagrammatic but shall be followed as closely as other work will permit. The drawings provide design intent. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.
- D. All sizes as given are minimum except as noted.
- E. Because of the scale of the Drawings, certain basic items, such as, pipe fittings, duct fittings, access panels, and sleeves, may not be shown. Where such items are required by Code or by other Sections, or where required for proper installation of the Work, such items shall be included, whether shown or not.
- F. In the event of any inconsistencies between the specifications, drawings, contract documents, applicable laws, statutes, ordinances, building codes, rules and regulations, the contractor shall provide the better quality or greater quantity of work and comply with or conform its work to the most stringent legal or contractual requirements.
- G. Changes from these drawings required to make this work conform to the building construction shall be made only with prior written approval of the Architect/Engineer. All proposed changes shall be shown on shop drawings. All measurements shall be verified by actual observation and all work shall fit in place meeting the approval of the Architect/Engineer.
- H. Equipment Specification may not deal individually with minute items required, such as, components, parts, controls, and devices which may be required to produce the equipment performance specified or as required to meet the equipment warranties. Where such items are required to make the system operational, they shall be included by the supplier of the equipment at no additional cost, whether or not specifically called for.

**1.02 SECTION INCLUDES**

- A. The work under this section includes basic electrical requirements, which are applicable to all Division 26 sections. This section includes information common to two or more technical specification sections or items that are of a general nature, not conveniently fitting into other technical sections.
  - 1. Submittals
  - 2. Construction Verification Checklists
  - 3. Functional Performance Tests
  - 4. Reference Standards
  - 5. Quality Assurance
  - 6. Guarantee
  - 7. Work by Owner
  - 8. Operation and Maintenance Instructions
  - 9. Record Documents
  - 10. Continuity of Existing Services
  - 11. Protection of Finished Surfaces
  - 12. Sealing and Firestopping

13. Off Site Storage
14. Regulatory Requirements
15. Certificates and Inspections
16. Coordination
17. Demolition and Existing Requirements
18. Request and Certification for Payment
19. Temporary Electrical Service
20. Approved Electrical Testing Laboratories
21. Sleeves and Openings
22. Omissions
23. Definitions
24. Project/Site Conditions
25. Work Sequence and Scheduling
26. Work by Other Trades
27. Salvage Materials
28. Training
29. Access Panels and Doors
30. Identification
31. Demolition
32. Excavation and Backfill
33. Concrete Work
34. Cutting and Patching
35. Lintels
36. Building Access
37. Equipment Access
38. Housekeeping and Clean Up

### **1.03 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this section. [Drawings and general provisions of the Contract, including supplementary conditions apply to this Section.]
- B. The electrical work included in all other divisions is the responsibility of the contractor performing the Division 26 work unless noted otherwise.
- C. Section 01 91 13 – Commissioning Requirements
- D. Division 21 – Fire Suppression
- E. Division 22 – Plumbing
- F. Division 23 – Heating, Ventilating and Air Conditioning
- G. Division 27 – Communications
- H. Division 28 – Electronic Safety and Security

### **1.04 SUBMITTALS**

- A. Submit shop drawings for equipment under each section per requirements listed in that section, as well as per Division 1.
- B. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission. Do not submit hard copies of web pages. Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project schedule.
- C. On request from the A/E, the successful bidder shall furnish additional drawings, illustrations, catalog data, performance characteristics, etc.
- D. Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.
- E. The submittals must be approved before fabrication is authorized.
- F. Provide electronic copies of all submittals for review.

- G. LEED Submittals: Credit EQ4.1: Low-Emitting Materials: Submit manufacturer's product data for adhesives and sealants, including printed statement of VOC content.

#### **1.05 CONSTRUCTION VERIFICATION CHECKLISTS**

- A. Contractor is responsible for utilizing the construction verification checklists supplied under these specifications in accordance with the procedures defined for construction verification checklists in Section 01 91 13 – Commissioning Requirements.

#### **1.06 FUNCTIONAL PERFORMANCE TESTS**

- A. Contractor is responsible for utilizing the functional performance test procedures supplied under these specifications in accordance with the procedures defined for functional performance test procedures in Section 01 91 13 – Commissioning Requirements.

#### **1.07 REFERENCE STANDARDS**

- A. Abbreviations of standards organizations referenced in this and other sections are as follows:
  1. ANSI American National Standards Institute
  2. ASTM American Society for Testing and Materials
  3. EPA Environmental Protection Agency
  4. ETL Electrical Testing Laboratories, Inc.
  5. IEEE Institute of Electrical and Electronics Engineers
  6. IES Illuminating Engineering Society
  7. ISA Instrument Society of America
  8. NBS National Bureau of Standards
  9. NEC National Electric Code
  10. NEMA National Electrical Manufacturers Association
  11. NESC National Electrical Safety Code
  12. NFPA National Fire Protection Association
  13. UL Underwriters Laboratories Inc.

#### **1.08 QUALITY ASSURANCE**

- A. Substitution of Materials: Refer to Division 1 for equals and substitutions.
  1. Where the following conflicts with Division 1, the requirements of Division 1 shall govern.
  2. If the Contractor wishes to submit an alternate to the named manufacturers for any equipment, he may submit a voluntary alternative minimum 7 days prior to bid, stating the manufacturer's name, model number, written, detailed product data.
  3. Where materials or equipment are specified by name the proposed material or equipment must be identical to the specified material or equipment in all characteristics of quality, function and serviceability, regardless of application in the Project and, in addition, when the Architect deems that aesthetic significance is important, the equal material or equipment must be identical in all characteristics of visual appearance, design, color and texture. Any proposed equal shall be submitted to Architect/Engineer for prior approval, which Architect/Engineer may approve or disapprove in its sole discretion. Work performed or constructed with unapproved equals is at Contractor's risk and any required correction of work incorporating unapproved equals shall be at Contractor's sole cost and expense.
  4. In all instances, Contractor shall assume full responsibility for proof of equality of the statute to the equipment hereinafter specified. All data and information necessary for proof of equality, function and space requirements shall be prepared and accompany the submittal of the substitution to the Architect/Engineer. Approval by the Architect/Engineer of equipment other than the specified does NOT relieve Contractor of this responsibility.
- B. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.
- C. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system, including, but not limited to, coordination with other trades and any required changes by other trades and for obtaining the intended performance from the system into which these items are placed.

- D. All materials shall be listed by and shall bear the label of an approved electrical testing laboratory. If none of the approved electrical testing laboratories has published standards for a particular item, then other national independent testing standards, if available, applicable, and approved by A/E, shall apply and such items shall bear those labels. Where one of the approved electrical testing laboratories has an applicable system listing and label, the entire system, except for medium voltage equipment and components, shall be so labeled.

#### **1.09 GUARANTEE**

- A. Refer to Division 1 for Guarantees and Warranties. In addition to the requirements in Division 1, this Contractor shall meet the following requirements.
- B. In entering into a contract covering this work, the contractor accepts the specifications and guarantees that the work will be carried out in accordance with the requirements of this specification or such modifications as may be made under the contract documents.
- C. Contractor further guarantees that the workmanship and material will be of the best procurable and that none but experienced workmen familiar with each particular class of work will be employed.
- D. Contractor further guarantees to replace and make good at his own expense, including travel time, all defects, which may develop within 1 year after final payment and acceptance by the Architect/Engineer, due to faulty workmanship or material, upon, receipt of written notification from the Owner.

#### **1.10 WORK BY OWNER**

- A. PCB equipment (other than light fixture ballasts) removal and disposal, if required, will be by the Owner under separate contract.
- B. Electrical testing not described in these contract documents will be by the Owner under separate contract.

#### **1.11 OPERATION AND MAINTENANCE INSTRUCTIONS**

- A. Refer to Division 1 for all operations and maintenance instructions.
- B. In addition to the general content specified under Division 1 supply the following additional documentation:
  - 1. Manufacturer's wiring diagrams for electrically powered equipment.
  - 2. Copies of all approved submittals along with approval letters.

#### **1.12 RECORD DOCUMENTS**

- A. Refer to Division 1 for record documents.
- B. In addition to the general content specified under Division, follow the following procedures.
  - 1. During the progress of the work, Contractor shall maintain a current (daily) record set of the drawings and specifications, indicating thereon all work installed at variance with such Contract Documents including, without limitation, work covered by Addenda, Field Work Orders, Change Orders and Engineers additional instructions, interpretations and clarification. All changes or deviations from the original layout of the work and all critical dimensions of buried or concealed work shall be recorded. It shall be Contractor's responsibility to assure that said record sets are complete, accurate and up-to-date, Engineer shall have the right to inspect and review such record sets.
  - 2. At the completion of the work, Contractor shall indicated on record sets all record changes and such additional details necessary or appropriate to provide a complete reference document for use by Engineer. If variations and details cannot be shown clearly thereon, the Contractor shall prepare supplemental drawings adequate to impart the information. The foregoing drawings collectively shall constitute the "Record" drawings for the work.
  - 3. All indication on "Record" drawings shall be executed in a legible manner at Contractor's cost, using methods and legend presentations compatible with the overall scheme of the record drawings with respect to scale, drawing sheet sizes and sequential indexing. All changes shall be marked clearly in red and clouded.
  - 4. Engineer may review Contractor's "Record" drawings and notify Contractor of observed discrepancies or deviations. Contractor shall promptly correct discrepancies, deviations or illegible markings at Contractor's expense and resubmit revised drawings for Engineer review.



5. Contractor shall provide final electronic record drawings to the Owner through the Engineer.
6. Engineer will provide final electronic record drawings to the Owner based on Contractor's markups.

#### **1.13 CONTINUITY OF EXISTING SERVICES**

- A. Do not interrupt or change existing services without prior written approval from the Owner's Project Representative. When interruption is required, coordinate scheduling of down-time with the Owner to minimize disruption to his activities. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.
- B. Each Contractor shall thoroughly familiarize himself with existing systems which will affect and be affected by relocation of existing equipment and installation of new lines and equipment. They shall plan installation of their work so that interruptions of services to any building or portion thereof will be a minimum and such interruptions shall occur only when system is not required, if possible. If not possible, each Contractor shall insure the operation of services by whatever means possible, such as, installing bypasses, capping of services or providing temporary service. Each interruption shall be for as short a duration as possible.
- C. No extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours.
- D. This Contractor shall restore any circuit interruption as a result of this work to proper operation as soon as possible. Note that institutional operations are on a seven day week schedule.

#### **1.14 PROTECTION OF FINISHED SURFACES**

- A. Refer to Division 1 for protection of finished services.
- B. Furnish one can of touch-up paint for each different color factory finish furnished by the Contractor. Deliver touch-up paint with other "loose and detachable parts" per Division 1.

#### **1.15 SEALING AND FIRESTOPPING**

- A. Sealing and firestopping of sleeves/openings between conduits, cable trays, wireways, troughs, cablebus, busduct, etc. and the structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and firestopping. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.
- B. Contractor shall request current life safety drawings from the Architect/Owner.

#### **1.16 OFFSITE STORAGE**

- A. If payment will be requested for approved offsite stored material, then the Contractor shall complete an "Off-site Storage Agreement" which is available from the Owner. Prior approval by Owner's personnel for offsite storage will be needed. No material will be accepted for offsite storage unless submittals for the material have been approved.

#### **1.17 REGULATORY REQUIREMENTS**

- A. All work and materials are to conform in every detail to applicable rules and requirements of the Wisconsin State Electrical Code Volumes 1 and 2, the National Electrical Code (ANSI/NFPA 70), other applicable National Fire Protection Association codes, the National Electrical Safety Code, present manufacturing standards (including NEMA) and the Authority Having Jurisdiction (AHJ).
- B. All Division 26 work shall be done under the direction of a currently certified State of Wisconsin Certified Master Electrician.

#### **1.18 CERTIFICATES AND INSPECTIONS**

- A. Refer to Division 1 for permits, regulations, utilities and taxes.
- B. Obtain and pay for all required State or local installation inspections except those provided by the Architect/Engineer in accordance with State Code. Deliver originals of these certificates to the Owner. Include copies of the certificates in the Operating and Maintenance Instructions.
- C. Coordinate and provide inspections as required by the Authority Having Jurisdiction over the site.

- D. This contractor is responsible for coordination of Owner's electrical inspection. Inspection requirements will be issued at a pre-installation meeting, arranged by this contractor and the Owner's Electrical Inspector (See Article 15 of the General Conditions).

#### **1.19 COORDINATION**

- A. Refer to Division 1 for coordination. In addition to the requirements specified under Division 1, the following requirements apply.
- B. It shall be the responsibility of each Contractor to coordinate and consult with each other to determine space requirements and to determine that adequate space for servicing is provided for all equipment whether furnished by the Contractor or others. The General Contractor shall have final decision on all space priority conflicts among Contractors. All space priority conflicts shall be brought to the attention of the Architect/Engineer and Owner's Representative.
- C. Each Contractor shall thoroughly familiarize himself with existing systems which will affect and be affected by relocation of existing equipment and installation of new lines and equipment. They shall plan installation of their work so that interruptions of services to any building or portion thereof will be a minimum, and such interruptions shall occur only when system is not required, if possible. If not possible, each Contractor shall insure the operation of services by whatever means possible, such as, installing bypasses, or providing temporary service or circuits. Each interruption shall be for as short a duration as possible.
- D. Cooperation among all Contractors shall be required. Any Work that is installed without cooperating or coordinating with other Contractors and is in conflict shall be removed and reinstalled at that particular Contractor's cost. No cost additions to the Project will be considered due to a Contractor's lack of participation in the cooperation and coordination process. The following list of items of Work shall be the priority of order for all Contractors:
  - 1. Structure
  - 2. Gravity-flow systems for sanitary, storm, steam and steam condensate piping
  - 3. Ductwork and appurtenances
  - 4. Electrical primary and secondary feeder conduits and low voltage cable tray
  - 5. Plumbing vent piping
  - 6. Fire protection (sprinkler system)
  - 7. HVAC piping
  - 8. Gas piping, process piping and domestic water
  - 9. Electrical branch circuit conduit and low voltage conduit
  - 10. Control air lines or conduit
- E. The above list, in descending order, is the precedence assigned the Work items for space priority. Gravity-flow systems have first priority.
- F. Exception: Plumbing lines below or behind plumbing fixtures shall have precedence over all other work. Electrical conduit above or below switchgear, panelboards and control panels shall have precedence over all other work. Do not install any fluid conveying piping over electrical or elevator equipment.
- G. In the case of interconnection of the work of two or more contractors, verify at the site or on shop drawings all dimensions relating to such work. All errors due to the failure to so verify any such dimensions shall be promptly rectified.
- H. Any installed work that is not coordinated and interferes with another contractor's work shall be removed or relocated at the installing contractor's expense.
- I. Prior to start of Construction, the General Contractor shall schedule a meeting with all of the Contractors responsible for the work items listed above. The purpose of the meeting is to introduce the coordination program and to determine its implementation in relation to the progress schedule.
- J. At the initial Coordination Meeting, the Mechanical Contractor / Ventilating Contractor shall provide to the General Contractor outline drawings at 1/4" scale indicating column centerlines, interior partition locations, and ceiling heights. The General Contractor shall verify all information shown on these drawings and relay any changes in the information to the Ventilation Contractor to be reflected on the Drawings. The Ventilating Contractor, with reference and consideration to the Structural, Heating, Electrical, Fire Protection, and Plumbing Drawings, shall draw to scale his proposed installation showing duct sizes, equipment layouts, and dimensions from column lines and from finished floors to bottom of ducts. Ductwork shall be maintained as tightly as possible to the underside

- of floor slabs and/or beams. For congested areas the Ventilating Contractor shall, in addition, prepare Drawings in section view. During this phase of the program, it shall be the Electrical Contractor's responsibility to furnish the Ventilating Contractor with recessed lighting installation and clearance requirements. This information shall be outlined on the Drawings by the Ventilating Contractor.
- K. The ductwork layouts shall be produced in sequence as mandated by the Project Schedule. The earliest area indicated in the Schedule shall receive the first effort, etc.
  - L. When the Ductwork Drawings for the earliest scheduled area have been completed (time limitation as determined at the initial coordination meeting), the Ventilating Contractor shall provide the General Contractor with one set of drawings for each participant in the effort. The General Contractor will distribute the drawings to the participating Contractors for their use in drawing thereon the major components of their proposed installation using the general scheme shown on the Contract Drawings as a guide.
  - M. The major components to be indicated include (but are not limited to) the following:
    - 1. Structure
    - 2. Roof drain leaders
    - 3. Above 3" waste piping
    - 4. Sprinkler mains
    - 5. Heating hot water mains
    - 6. Chilled water mains
    - 7. Significant primary and secondary feeder conduit runs
    - 8. Cable trays
    - 9. Contract ceiling heights
    - 10. Soffits
    - 11. Access points
    - 12. Fire wall penetrations
    - 13. Steam and condensate mains
    - 14. Gas, water, and process piping
  - N. Information delineated shall be distance from column centerlines, pipe/equipment size, and distance from finished floor to bottom of pipe/equipment and hangers. Included on the Drawings shall be piping layout with hanger locations and hanger point loads. This information shall be developed satisfactorily enough to allow the Structural Engineer to verify the adequacy of the structural system for the projected loads. The hanger locations may have to be moved depending on the structural system review. No hanger shall be fabricated and/or installed until the hanger locations are reviewed and accepted by the Architect/Engineer.
  - O. Within a period not to exceed two weeks after distribution of the drawings, the General Contractor will schedule a meeting with the Architect/Engineer and participating Contractors at which time areas of conflict shall be resolved. The drawings shall be overlaid to identify areas of conflict. All parties shall then cooperate in resolving the conflicts. Records of the agreements shall be entered on the Ventilating Contractor's drawings, acknowledged by all participants by signature in space provided for this purpose, and two copies distributed to all involved parties. All coordination drawing preparation and reproduction costs shall be borne by the Ventilating Contractor. The above drawings, review, and coordination process shall be repeated until all areas on the Project have been coordinated.
  - P. In the event a Contractor fails to cooperate in the Coordination Program, they shall be held responsible for all costs incurred for adjustments to the work of others made necessary to accommodate the uncooperative Contractor's installations.

#### **1.20 DEMOLITION AND EXISTING REQUIREMENTS**

- A. Existing active services: water, gas, steam, ventilation, compressed or control air, sanitary waste, sanitary vent, storm electric, and any other building systems when encountered shall be protected against damage. Where existing services are to be abandoned, the services shall be removed back to the point of origin and removed from the site unless otherwise directed by the Owner's Representative.
- B. Submit a "Sequence of Work Schedule" in respect to all temporary and permanent utility and service cutovers after final determination. This schedule shall be submitted for approval to the Owner and Architect/Engineer. The submittal shall designate priority order, service or utility affected, date of cutover, and time of day to start and finish.

- C. Bidders should inspect the site to become familiar with conditions of the site which will affect the Work. Bidders should verify points of connection with utilities, routing of outside piping to include required clearances from any existing structures, or other obstacles.
- D. Extra payment will not be allowed for changes in the Work required because of the successful bidder's failure to make this inspection.

#### **1.21 REQUEST AND CERTIFICATION FOR PAYMENT**

- A. Within 10 days after Notice to Proceed, the successful bidder will submit to the Owner's Project representative in a form prescribed by Division 1, a cost breakdown of the proposed values for work performed which, if approved by the Owner's project representative, will become the basis for construction progress and monthly payments. The cost breakdown items shall reflect actual work progress stages as closely as feasible.
- B. In addition, if payment will be requested for approved off-site stored material, then that material shall be listed as a line item in the request and certification for payment cost breakdown.

#### **1.22 TEMPORARY ELECTRICAL WORK**

- A. Any Trade that has a temporary office shall provide and pay for installation of temporary service for lighting of such temporary office.
- B. The temporary lighting system shall be sufficient to enable all trades to safely complete their work and to enable Owner's Project Representative to check all work as it is being done. Illumination shall be 5 foot-candles minimum in all areas and, [in addition, shall meet or exceed the requirements of 29 CFR 1926.56 Illumination (OSHA regulations).] (WI only)
- C. Provide at least two duplex outlets for small power tools for each 400 square feet of floor space, 120 volt single phase. Locate duplex outlets so that the power is available at any point of use with not more than 100 ft. power cord. Circuits shall be 20 ampere, single pole.
- D. All Trades shall furnish their extension cords and lamps other than those furnished for general lighting.
- E. All Trades and other separate Contractors shall be allowed to use the service provided for general lighting and fractional horsepower hand tools at no cost.
- F. Those trades requiring lighting or other electrical service outside of building shall pay for the installation and removal of service, maintenance charges, and energy consumed.
- G. Trades requiring voltage other than basic temporary system specified, three phase power, or a special single phase run, for operation of construction equipment or testing shall make their own arrangements with the General Contractor for cost of energy used, and the Electrical Trade for the cost of installation, and removal when no longer required.
- H. Heating and Ventilating Trade shall provide wiring, equipment and connections for portable or temporary heating units.

#### **1.23 APPROVED ELECTRICAL TESTING LABORATORIES**

- A. The following laboratories are approved for providing electrical product safety testing and listing services as required in these specifications:
  - 1. Underwriters Laboratories Inc.
  - 2. Electrical Testing Laboratories, Inc.

#### **1.24 SLEEVES AND OPENINGS**

- A. Openings required in new or existing construction that may be necessary for the installation of new work shall be provided by the respective contractor and all patching and repairing shall be done by workmen competent in the trade required, at the expense of the respective contractor. The respective contractor shall be responsible for arranging the work so that minimum cutting will be required. All rubbish and excess materials involved in such cutting shall be promptly removed from the site and disposed of by the contractor. Cutting through the floor or roof systems or load bearing walls shall be done only with the prior written approval of the Architect/Engineer so as to avoid damaging the structural system.

**1.25 OMISSIONS**

- A. No later than ten (10) days before bid opening, the Contractor shall call the attention of the A/E to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

**1.26 DEFINITIONS**

- A. Wherever the words “the Contractor”, “this Contractor” or “Electrical Contractor”, appear in this section, they refer to the Contractor for Electrical Work.
- B. The term “provide” includes such labor, methods, materials, equipment and transportation or other facilities required to complete the Contract and the performance of all duties thereby upon the Contractor.

**1.27 PROJECT/SITE CONDITIONS**

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of A/E before proceeding.
- C. Tools, materials and equipment shall be confined to areas designated by the Owner’s project representative.

**1.28 WORK SEQUENCE AND SCHEDULING**

- A. Install work in phases to accommodate Owner's occupancy requirements. During the construction period coordinate schedule and operations with Owner's Construction Representatives.

**1.29 WORK BY OTHER TRADES**

- A. Every attempt has been made to indicate in this trade's specifications and drawings all work required of this Contractor. However, there may be additional specific paragraphs in other trade specifications and addenda, and additional notes on drawings for other trades which pertain to this Trade's work, and thus those additional requirements are hereby made a part of these specifications and drawings.
- B. Electrical details on drawings for equipment to be provided by others are based on preliminary design data only. This Contractor shall lay out the electrical work and shall be responsible for its correctness to match equipment actually provided by others.

**1.30 SALVAGE MATERIALS**

- A. No materials removed from this project shall be reused (except as specifically noted below). All materials removed shall become the property of and shall be disposed of by the Contractor.

**1.31 TRAINING**

- A. Refer to Section 01 91 13 Commissioning Requirements for training requirements.
- B. The contractor shall have the following responsibilities:
- C. Provide a training plan sixty days before the planned training covering the following elements:
  - 1. Equipment
  - 2. Intended audience
  - 3. Location of training
  - 4. Objectives
  - 5. Subjects covered (description, duration of discussion, special methods, etc.)
  - 6. Duration of training on each subject
  - 7. Instructor for each subject
  - 8. Methods (classroom lecture, manufacturer’s quality video, site walk-through, actual operational demonstrations, written handouts, etc.).
- D. Provide designated owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment that makes up the system.
- E. Training shall normally start with classroom sessions followed by hands-on demonstration/training on each piece of equipment.

- F. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system shall be repaired or adjusted as necessary and the demonstration repeated at another scheduled time, if necessary.
- G. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
- H. The controls contractor shall attend sessions other than the controls training, as specified, to discuss the interaction of the controls system as it relates to the equipment being discussed.
- I. The training sessions shall follow the outline in the table of contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
- J. Training shall include:
  - 1. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
  - 2. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include startup, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
  - 3. Discussion of relevant health and safety issues and concerns.
  - 4. Discussion of warranties and guarantees.
  - 5. Common troubleshooting problems and solutions.
  - 6. Explanatory information included in the O&M manuals.
  - 7. Discussion of any peculiarities of equipment installation or operation.
  - 8. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.
  - 9. Hands-on training shall include startup, operation in all modes possible, including manual, shut-down, alarms, power failure and any emergency procedures, and preventative maintenance for all pieces of equipment.
- K. The contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls not controlled by the central control system.
- L. Video recording of the training sessions will be provided by the contractor and added to the O&M manuals. In addition, factory training videos identifying key troubleshooting, repair, service and/or replacement techniques shall be provided and reviewed with the owner.
- M. Provide a minimum of 16 hours of instruction. Engineer to provide number of hours based on owner's staff and the size of the project. This training is for general operation, equipment training is included in each equipment specification.
- N. Provide additional training as specified in other specification sections for specific equipment.

## **PART 2 - PRODUCTS**

### **2.01 ACCESS PANELS AND DOORS**

- A. Plaster Walls and Ceilings:
  - 1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers and similar wet areas, concealed hinges, screwdriver operated cam latch for general application, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" by 12".

### **2.02 IDENTIFICATION**

- A. Refer to Electrical Section 26 05 53 – Identification for Electrical Systems.

## **2.03 SLEEVES AND OPENINGS**

### **A. General:**

1. Pipe sleeves shall be constructed of standard weight ASTM A53 or ASME B36.10 steel with an anchor plate constructed of A36/A36M steel welded to the pipe. The sleeve shall be sized a minimum of 1" larger than piping insulation diameter. The entire assembly shall be hot-dip galvanized after fabrication.
2. Duct sleeves and piping sleeves passing through interior walls shall be constructed of 24 gauge galvanized steel minimum thickness.

### **B. Sleeves Through Below Grade Walls:**

1. Provide steel pipe sleeve, ASTM A53, pressure sealing with membrane clamp ring, gasket, water stop ring, external rings, and nitrile rubber link seals. The assembly shall be hot-dip galvanized after fabrication.
  - a. Seals: Modular mechanical type seals, consisting of interlocking nitrile rubber links shaped to continuously fill the annular space between the pipe and the sleeve and electrically isolate the carrier pipe from the steel sleeve.
  - b. Sealing Element: Polychloroprene rubber material compounded to resist aging, ozone, sunlight, hydrocarbon gases, water, and chemical action.
  - c. Hardware: Type 300 series stainless steel fasteners. Threads rolled to produce smooth uniform threads and unbroken flow lines.
  - d. Compression Plates: Fiberglass-reinforced polyester plastic, injection molded for high physical properties, dielectric strength and non-cold flow creep characteristics, having high resistance to acidic and alkaline soils.
2. For sleeves located 15 feet or more below grade provide cast iron sleeve ASTM A74 with compression seals.

## **2.04 SEALING AND FIRESTOPPING**

### **A. Fire And/Or Smoke Rated Penetrations:**

1. Manufacturers:
  - a. 3M, STI/SpecSeal, Tremco, Hilti
  - b. All firestopping systems shall be by the same manufacturer.
2. Submittals:
  - a. Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.
3. Product:
  - a. Firestop systems shall be UL listed or tested by an independent testing laboratory approved by the Owner and the Authority Having Jurisdiction (AHJ).
  - b. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
  - c. Contractor shall use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.
  - d. All sealants shall meet the intent of LEED® VOC requirements, <250 g/L VOC contents (less H<sub>2</sub>O and exempt solvents).

### **B. Non-Rated Penetrations:**

1. Conduit Penetrations Through Below Grade Walls:
  - a. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated conduit and the cored opening or a water-stop type wall sleeve.
2. Conduit and Cable Tray Penetrations:

- a. At conduit and cable tray penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between conduit and sleeve, or the core drilled opening.

## **PART 3 – EXECUTION**

### **3.01 DEMOLITION**

- A. Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to be performed adjacent to existing work that remains in an occupied area, construct temporary dust partition to minimize the amount of contamination of the occupied space. Where pipe is removed and not reconnected with new work, cap ends of existing services as if they were new work. Coordinate work with the Owner to minimize disruption to the existing building occupants.
- B. All devices, fixtures, equipment, wiring and associated conduit, insulation and similar items demolished, abandoned, or deactivated are to be removed from the site by the Contractor except as specifically noted otherwise. All designated equipment is to be turned over to the owner for their use at a place and time so designated. Maintain the condition of material and/or equipment that is indicated to be reused equal to that existing before work began.
- C. All contractors requiring the personnel/ material hoist and or temporary construction elevator (i.e. new elevators, temporarily protected) at times other than outlined in the temporary facilities specifications will make arrangements directly with the general contractor. The general contractor is responsible for all coordination and scheduling of the use of any hoisting equipment so the flow of the project is smoothly maintained and all workers have access to the work areas to perform their work and deliver material to the areas needed according to the project schedule.
- D. If any contractor's work requires the removal and replacement of any finished materials including but not limited to such materials as ceiling tiles, wall finishes, cabinets, doors, flooring, windows, etc. after those items are installed, each contractor will be responsible, at no additional cost to the owner, to replace any damaged, soiled or lost materials with new materials to match the existing materials and those materials damaged.

### **3.02 EXCAVATION AND BACKFILL**

- A. Perform all excavation and backfill work to accomplish indicated mechanical systems installation in accordance with Division 31. Blasting will not be allowed without written permission of the Architect/Engineer and the owner.
- B. Install lines passing under foundations with minimum of 1-1/2 inch clearance to concrete and insure there is no disturbance of bearing soil.

### **3.03 CONCRETE WORK**

- A. Coordinate the quantity and location of all cast-in-place concrete work with the architectural drawings. It is desired that the Electrical Contractor perform no concrete work.
- B. The Division 3 Contractor will perform all cast-in-place concrete unless noted otherwise elsewhere. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for the support of electrical equipment.
- C. Required concrete and reinforcing steel shall be as specified in Section 03 30 00. Use only approved equipment shop drawings for dimensions.
- D. Concrete equipment pads shall extend 3" beyond equipment in each direction. Chamfer top edges 1/2". Trowel all surfaces smooth.
- E. Concrete equipment pads: Provide 3 1/2" minimum thickness reinforced concrete bases under equipment installed on building floors. Rough up building floor to assure bonding of base to floor. Anchor base to floor with reinforcing bars set in floor at tie of pouring of floor or with power driven studs. Set required equipment anchor bolts in base at time of pouring.

### **3.04 CUTTING AND PATCHING**

- A. Refer to Division 1 for cutting and patching. In addition to the requirements in Division 1:
- B. Each Contractor shall coordinate the placing of openings in the new structure as required for the installation of each Contractor's work.



- C. Each Contractor shall furnish to the General Contractor the accurate locations and sizes for required openings in the new work, but this shall not relieve each Contractor of the responsibility of checking to assure that properly sized openings are provided. When additional patching is required due to the Contractor's failure to inspect this work, then the Contractor shall make arrangements for the patching required to properly close the openings to include patch painting, and the Contractor shall pay any additional cost incurred in this respect.
- D. If cutting and patching of the new structure is made necessary due to the Contractor's failure to install piping, ducts, sleeves, or equipment on schedule, or due to the Contractor's failure to furnish on schedule the information required for the leaving of openings, then it shall be the Contractor's responsibility to make arrangements and obtain approval from the General Contractor and Architect/Engineer for this cutting and patching, and the Contractor shall pay any additional cost incurred in this respect. The Contractor shall also reimburse the Owner for any additional costs incurred to the Architect/Engineer for additional services caused by the Contractor in this respect.
- E. The Contractor shall provide cutting and patching and patch painting in the existing structure as required for the installation of his Work and shall furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Architect/Engineer. Extent of cutting shall be minimized; use core drills, power saws, or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

### **3.05 LINTELS**

- A. All steel lintels required for opening in existing and/or new masonry walls shall be provided under Section 05 50 00 – Metal Fabrications. This contractor shall design, fabricate, and install all lintels required in masonry walls for conduit and cable tray penetrations. Contractor shall submit design drawings of lintels with professional engineers seal and signature prior to installation.

### **3.06 BUILDING ACCESS**

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

### **3.07 EQUIPMENT ACCESS**

- A. Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster or drywall walls or ceilings, furnish the access doors to the General Contractor and reimburse the General Contractor for installation of those access doors.
- B. The approximate location of all equipment and devices is shown on the drawings. The Architect/Engineer reserves the right to change the location of all equipment or devices 6 feet in any direction at no additional cost provided such changes are requested before final installation.
- C. Install all equipment with ample space allowed for removal and repair. Provide ready accessibility to removable parts of equipment and to all wiring without moving equipment which is installed or which is already in place.
- D. In mechanical and electrical equipment spaces, expose ceiling outlets and conduit with due consideration to ventilating ducts and mechanical piping. Where numerous ducts occur, install conduits and outlets after the ventilating ducts. Puncturing of ductwork or hanging equipment such as light fixtures, ceiling hangers and conduits from ductwork is prohibited unless specifically noted otherwise.
- E. Electrical equipment shall be installed to maintain minimum clearances per Article 110 of NEC and ANSI C2 (National Electrical Safety Code).
- F. No piping carrying fluids shall be installed directly over electrical equipment.
- G. Equipment shall be installed in accordance with manufacturer's recommendation. Where conflicts occur between Contract Document and these recommendations, a ruling shall be requested of the Architect for decision before proceeding with such work.

### **3.08 COORDINATION**

- A. The Contractor shall cooperate with other trades in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.
- B. The Contractor shall verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to light fixtures, panelboards, devices, etc. and recessed or semi-recessed heating units installed in/on architectural surfaces. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls and other structural components as they are constructed.
- C. Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
- D. Coordinate arrangements, mounting and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays and busways will be clear of obstructions and of the working and access space of other equipment.
- E. Coordinate with Division 27 and 28 contractors and equipment vendors for proper location, quantity and capacity of all required conduits, back boxes, device rings and power supplies required to support systems specified.
- F. Cooperate with the testing consultant in ensuring Section 26 05 04 compliance. Verify system completion to the testing consultant. Demonstrate the starting, interlocking and control features of each system so the testing contractor can perform its work.

### **3.09 SLEEVES AND OPENINGS**

- A. General:
  - 1. Sleeves are not required for piping and ducts passing through interior non-rated drywall, plaster, or wood partitions and interior poured concrete walls that have been saw cut or core drilled.
  - 2. Pack annular space between sleeves and pipe or ducts with fiberglass insulation and seal.
  - 3. Piping sleeves that pass through fire rated floors, walls, or ceilings shall be provided with a UL listed fire stop material meeting UL 1479 to seal the opening between the pipe and the pipe sleeve to maintain the fire rating.
  - 4. Provide escutcheon plates on piping to cover sleeve and insulation in finished areas.
  - 5. Refer to Division 1, General Requirements for additional information on sleeves and openings.
- B. Sleeves Through Floors/Ceilings:
  - 1. Sleeves shall be installed to extend 1 inch above finished floor with a watertight sealant between floor and sleeve in all mechanical rooms and wet rooms listed below.
  - 2. If a sleeve is not provided, provide 1-1/2 inch angle ring with urethane caulk between the angle and the floor and seal at the corners to form a watertight seal.
  - 3. Wet Locations:
    - a. Mechanical Rooms
    - b. Food service/kitchen areas (behind/under equipment, cabinets, tables, etc.)

### **3.10 SEALING AND FIRESTOPPING**

- A. The Contractor shall refer to building life safety drawings for all smoke and fire rates in addition to the mechanical drawings. Any discrepancies shall be brought to the attention of the Architect/Engineer before final addendum.
- B. Fire and/or Smoke Penetrations:
  - 1. Install approved product in accordance with the manufacturer's instructions where a pipe (i.e. cable tray, bus, cable bus, conduit, wireway, trough, etc.) penetrates a fire rated surface.

2. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any substantial weight.
- C. Non-Rated Surfaces:
1. When the opening is through a non-fire rated wall, floor, ceiling or roof the opening must be sealed using an approved type of material.
  2. Install escutcheons or floor/ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces for this paragraph include only those rooms with finished ceilings and the penetration occurs below the ceiling.
  3. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the conduit and tighten in place, in accordance with the manufacturer's instructions. Install so that the bolts used to tighten the seal are accessible from the interior of the building or vault.

### **3.11 HOUSEKEEPING AND CLEAN UP**

- A. The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

END OF SECTION

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**SECTION 26 05 02  
ELECTRICAL DEMOLITION FOR REMODELING**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes selective and/or total demolition of all existing electrical equipment, devices, conduit, wiring, back boxes and supporting associated devices for the electrical systems.

**1.02 SECTION INCLUDES**

- A. Materials and Equipment

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 27 – Communications
- C. Division 28 – Electronic Safety & Security

**PART 2 - PRODUCTS**

**2.01 MATERIALS AND EQUIPMENT**

- A. Materials and equipment for patching and extending work as specified in the individual Sections.

**PART 3 - EXECUTION**

**3.01 EXAMINATION**

- A. Verify field measurements and circuiting arrangements as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Verify whether or not PCB ballasts exist in light fixtures which will be disposed of. If PCB light fixture ballasts exist, then follow requirements in PCB BALLAST HANDLING AND DISPOSAL below.
- D. Demolition Drawings are based on casual field observation and/or existing record documents. Report discrepancies to the Owner, Architect/Engineer and Owner's Field Representative before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

**3.02 PREPARATION**

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Coordinate utility service outages with the Owner, Owner's Field Representative, Architect, and Engineer. Also, if applicable, coordinate utility service outages with the local Utility Company.

**3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

- A. Demolish and extend existing electrical work to meet all requirements of these specifications.
- B. If certain raceways and boxes are abandoned but not scheduled for removal, those items must be shown on the "As Built Drawings".
- C. Remove, relocate, and extend existing installations to accommodate new construction.
- D. Remove abandoned wiring to source of supply.
- E. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- F. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- I. Repair adjacent existing construction and finishes damaged during demolition and extension work to match adjacent existing surfaces.
- J. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. This includes the extension of the circuit from the last active device to the next device in the system to be activated.

### **3.04 PCB BALLAST HANDLING AND DISPOSAL**

- A. Generally, all high power factor fluorescent light ballasts manufactured before 1978 and some HID ballasts contain PCB compounds in their capacitors. The Contractor shall inspect all ballasts in all light fixtures and take the actions described below.
- B. All ballasts labeled as "NON-PCBs" or "NO PCBs" shall become the responsibility of the Contractor. If the PCB content is not stated on the ballast label, the ballast shall be handled as a PCB ballast.
- C. All PCB ballasts shall be removed from the light fixtures and shall have the wires clipped off. However, before removal, all PCB ballasts shall be carefully inspected for leaks. If a ballast appears to be leaking (evidenced by potting compound leaking out or by an oily film on the ballast surface) the ballast must be handled per EPA and DNR PCB regulations. Basically, this means the ballast is to be carefully removed from the fixture and placed in an approved drum. See paragraph below for the drum specifications. The person removing the ballast from the fixture shall wear protective gloves, eye protection, and protective clothing as necessary.
- D. If the fixture has also been contaminated, it must be cleaned to less than 10 micrograms/100 square centimeters contamination before disposal. This cleaning must be done by an approved PCB contractor and is not considered a part of this contract. Contact Owner for contractor approval before commencing with the cleanup.
- E. The ballasts shall then be placed in US DOT approved type 17C or type 17H drums (barrels) furnished by Veolia Environmental Services. The quantity and size of the drums will be determined by the contractor at the time of construction, - 30 and 55 gallon drums are typically available.
- F. These barrels shall be placed in storage with the cover that came with the barrels, in a location within a building, as designated by the Building Manager or Owner's project representative. The barrels are not to be placed outside where they are exposed to weather.
- G. THESE BALLASTS ARE NOT TO BE REMOVED FROM THE WORK SITE BY THE CONTRACTOR. To do so, would be a violation of DNR and DOT hazardous waste regulations and may result in a fine to the Contractor.
- H. The Contractor shall label and mark the PCB storage drums with EPA approved PCB labels and the storage area with signs, marks and lines to meet the regulations of Wisconsin Code NR 157.
- I. The Contractor shall also provide approved PCB absorbent materials to be stored immediately adjacent to the drum storage area. Do not place loose absorbent material in the drums.
- J. The Contractor shall provide to the Owner's Project representative, in written form, a total count of these ballasts (or their total weight by barrel) and where they are stored.
- K. See Lamp and Ballast Handling and Disposal instructions below.

### **3.05 LAMP AND BALLAST HANDLING AND DISPOSAL**

- A. All lamps (fluorescent, incandescent, and HID) contain mercury and/or lead (in the base) as well as other heavy metals and compounds which are regulated by the EPA and DNR during the disposal process. As a result, regulations have been issued covering the handling and disposal of all lamps. Therefore, lamps which have been removed from service for disposal shall be handled as follows by the Contractor.
- B. The Contractor shall very carefully remove all lamps (fluorescent, incandescent, and HID) from light fixtures before removal of the fixture from its mounted position. This is to reduce the likelihood that the lamp(s) will be broken. If the Contractor breaks more than 1% of the total lamps removed for the project, the Contractor will be charged the cost difference between disposal of broken lamps and

- disposal of unbroken lamps for all lamps broken in excess of 1% of the total lamps removed in the project.
- C. The contractor shall contact Veolia Environmental Services (1-800-358-9095 or 262-243-8917) to coordinate the storage and pickup of disposed lamps and ballasts. The contractor shall obtain containers from Veolia Environmental Services, for the storage of lamps and ballasts. Removed lamps and ballasts shall be placed in containers by the contractor, marked with the number and type of lamp and ballast, and placed in storage at a location on the Owner's property. The contractor shall label the area as "Hazardous Material Storage – Mercury". The contractor shall make arrangements for pickup of the lamps and ballasts with Veolia Environmental Services, shall provide a count of all stored lamps and ballasts, and shall fill out any required forms.
  - D. When making disposal arrangements with Veolia Environmental Services, the contractor shall notify them of the Owner's project name and number, and the Owner's project manager, for invoicing purposes. Invoicing from Veolia Environmental Services shall be sent to the Owner's project manager for direct charge payment from that project (lamp and ballast disposal costs to be paid by Owner).
  - E. The contractor shall coordinate the lamp and ballast disposal with the Owner's field representative.

### **3.06 CLEANING AND REPAIR**

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts (if required) and broken electrical parts.

### **3.07 INSTALLATION**

- A. Install relocated materials and equipment under the provisions of other sections.

END OF SECTION

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**SECTION 26 05 04**  
**CLEANING, INSPECTION, AND TESTING OF ELECTRICAL EQUIPMENT**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes the required cleaning, repair, adjustment, calibration, maintenance and testing of electrical equipment, as specified herein. This applies only to new electrical and existing electrical equipment being furnished, modified, worked on or serviced by this contractor for this project. Additional testing may be required and specified in other Division 26 sections and shall also be provided.

**1.02 SECTION INCLUDES**

- A. General Inspection and Cleaning of All Electrical Equipment
- B. Grounding Systems
- C. Instrument Transformers
- D. Protective Relays
- E. Metering and Instrumentation
- F. Battery Systems
- G. Mechanical and Electrical Interlock System
- H. Dry Type Transformers
- I. Ground Fault Systems
- J. Cables
- K. Panelboards
- L. Light Fixtures
- M. Occupancy Sensors
- N. Battery Pack Emergency Lighting
- O. Motor Starters and Motor Control Centers

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 26 05 00 – Common Work Results for Electrical
- C. Division 27 – Communications
- D. Division 28 – Electronic Safety & Security

**PART 2 – PRODUCTS**

**2.01 NOT USED.**

**PART 3 – EXECUTION**

**3.01 GENERAL INSPECTION AND CLEANING OF ALL ELECTRICAL EQUIPMENT**

- A. Inspect for physical damage and abnormal mechanical and electrical conditions.
- B. Any item found to be out of tolerance, or in any other way defective as a result of the required testing, shall be reported to the A/E. Procedure for repair and/or replacement will be outlined. After appropriate corrective action is completed the item shall be re-tested.
- C. Compare equipment nameplate information with the latest single line diagram and report any discrepancies.
- D. Verify proper auxiliary device operation and indicators.
- E. Check tightness of accessible bolted electrical joints. Use torque wrench method.
- F. Make a close examination of equipment and remove any shipping brackets, insulation, packing, etc. that may not have been removed during original installation.

- G. Make a close examination of equipment and remove any dirt or other forms of debris that may have collected in existing equipment or in new equipment during installation.
- H. Clean All Equipment:
  1. Vacuum inside of panelboards, transformer core and coils, fire alarm panels, comm/data, security panel, etc.
  2. Loosen attached particles and vacuum them away.
  3. Wipe all insulators with a clean, dry, lint free rag.
  4. Clean insulator grooves.
  5. Re-vacuum inside surfaces as directed by the Owner's Construction Representative or Inspector
- I. Inspect equipment anchorage.
- J. Inspect equipment and bus alignment.
- K. Check all overload elements for operation and control.
- L. Lubricate nonelectrical equipment per manufacturer's recommendations.

### **3.02 GROUNDING SYSTEMS**

- A. Inspect the ground system for adequate termination at all devices.

### **3.03 BATTERY SYSTEMS**

- A. Inspect for physical damage and evidence of corrosion. Clean units.
- B. Measure system charging voltage and each individual cell voltage.
- C. Measure the electrolyte specific gravity and level.
- D. Verify and compare measured values with manufacturer's specifications.

### **3.04 MECHANICAL AND ELECTRICAL INTERLOCK SYSTEM**

- A. Physically test each system to insure proper function, operation and sequencing.
- B. Closure attempt shall be made on locked open devices.
- C. Opening attempt shall be made on locked closed devices.
- D. Key exchange shall be made with devices operated in off normal positions.

### **3.05 LIQUID (OIL) FILLED TRANSFORMERS**

- A. Test and adjust cooling fans, controls and alarm function.

### **3.06 DRY TYPE TRANSFORMERS**

- A. Test and adjust the cooling fans, controls and alarm functions.
- B. Measure secondary voltage phase-to-phase and phase-to-ground after final energization and prior to loading.
- C. Verify and/or connect transformer "XO" to ground, load side of "WYE" systems.

### **3.07 CABLES**

- A. Visual and Mechanical Inspections:
  1. Inspect exposed sections for physical damage.
  2. Verify cable is supplied and connected in accordance with single line diagram.
  3. Inspect for shield grounding, cable support and termination.
  4. Inspect for visual jacket and insulation condition.
  5. Visible cable bends shall be checked against ICEA or manufacturer's minimum allowable bending radii -- 12 times the diameter for tape shielded cables.
  6. Inspect for proper fireproofing in common cable areas.
  7. There shall be NO tests performed on existing cable without specific direction from the Consulting Engineer.
- B. Electrical Tests -- Below 600 Volts:
  1. Visually inspect cables, lugs, connectors and all other components for physical damage and proper connections
  2. Check all cable connectors for tightness (with a torque wrench) and clearances. Torque test conductor and bus terminations to manufacturer's recommendations.
  3. Check for proper grounding resistance at all services and at transformers. Resistance shall be 2 ohms maximum.

**3.08 PANELBOARDS**

- A. Torque all the connections per the manufacturers spec. Verify phase wires, color coding, separate neutral and mechanical bonding. Verify circuit breaker operation. Verify the directory.

**3.09 LIGHT FIXTURES**

- A. Check the bonding and proper lamping. Verify that recessed fixtures are installed with hold down clips. Confirm operation of the fixture with the proper switch or sensor.

**3.10 OCCUPANCY SENSORS**

- A. Confirm operation of the sensor per the manufacturers spec.

**3.11 BATTERY PACK EMERGENCY LIGHTING**

- A. Verify the operation per the manufacturers spec and run all of the diagnostic steps. Confirm proper grounding and location.

**3.12 MOTOR STARTERS AND MOTOR CONTROL CENTERS**

- A. Verify the control circuits. Confirm the fusing and the grounding of the control transformers. Torque all of the connections. Confirm the overload elements and the circuit breakers(fuse) for proper sizing. Verify all grounding. Operate and test each motor starter for proper operation.

END OF SECTION

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**SECTION 26 05 19**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes furnishing and installing required wiring and cabling systems including pulling, terminating and splicing.

**1.02 SECTION INCLUDES**

- A. General
- B. Manufacturers
- C. Building Wire
- D. Underground Wire For Exterior Work
- E. Wiring Connectors

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 26 05 00 – Common Work Results for Electrical
- C. Section 26 05 26 – Grounding and Bonding for Electrical Systems
- D. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- E. Section 26 05 53 – Identification for Electrical Systems.

**1.04 SUBMITTALS**

- A. Submit product data: Provide for each cable assembly type.
- B. Submit factory test reports: Indicate procedures and values obtained.
- C. Submit shop drawings for modular wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.
- D. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

**1.05 REFERENCE STANDARDS**

- A. NFPA 70 - National Electrical Code
- B. IPCEA S-61-402/NEMA WC-5 Thermoplastic Insulated Wire and Cable
- C. IPCEA S-66-524/NEMA WC-7 Cross-linked Thermosetting Polyethylene-Insulated Wire and Cable
- D. UL 83
- E. ASTM

**1.06 PROJECT CONDITIONS**

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.
- D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

**PART 2 – PRODUCTS**

**2.01 GENERAL**

- A. All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock. All conductors shall be copper.
- B. All cable and wire shall have 600 volts insulation, have a conductivity of 98 percent, and shall be annealed coated copper per ASTM B33 or B189.

- C. Wire sizes No. 12 AWG and smaller shall be solid wire, and wire No. 10 AWG and larger shall be stranded, Class B, ASTM B8.
- D. Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods: e.g. stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back wired method.
- E. Minimum wire sizes shall be as follows:
  - 1. Power wiring- #12 AWG
  - 2. Control Wiring- #18 AWG
- F. All conductors shall be continuous without splices except at locations approved for the purpose.

## **2.02 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - 1. Alcan Products Corporation; Alcan Cable Division
  - 2. American Insulated Wire Corp.; a Leviton Company
  - 3. General Cable Corporation
  - 4. Senator Wire & Cable Company
  - 5. Southwire Company
  - 6. Houston Wire & Cable
  - 7. AFC Cable Systems, Inc.
  - 8. Hubbell Power Systems, Inc.
  - 9. O-Z/Gedney; EGS Electrical Group, LLC
  - 10. 3M; Electrical Products Division
  - 11. Tyco Electronics Corp.

## **2.03 BUILDING WIRE**

- A. Description: Single conductor insulated wire.
- B. Insulation: Type THHN/THWN, XHHW-2 insulation for feeders and branch circuits.

## **2.04 UNDERGROUND WIRE**

- A. Description: Stranded single or multiple conductor insulated wire.
- B. Insulation: Type XHHW-2 or USE.

## **2.05 WIRING CONNECTORS**

- A. Split Bolt Connectors: Not acceptable.
- B. Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment pads or terminals. Not approved for splicing.
- C. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
- D. All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.
- E. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.
- F. Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic copper tubing; internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps.

## **PART 3 – EXECUTION**

### **3.01 GENERAL WIRING METHODS**

- A. All wire and cable shall be installed in conduit.
- B. Do not use wire smaller than 12 AWG for power and lighting circuits.
- C. All conductors shall be sized to prevent excessive voltage drop at rated circuit ampacity. As a minimum use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 100 feet (30 m), and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet (61 m).

- D. Make conductor lengths for parallel conductors equal.
- E. Splice only in junction or outlet boxes.
- F. No conductor less than 10 AWG shall be installed in exterior underground conduit.
- G. Identify ALL low voltage, 600v and lower, wire per section 26 05 53.
- H. Neatly train and lace wiring inside boxes, equipment, and panelboards.

### **3.02 WIRING INSTALLATION IN RACEWAYS**

- A. Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling 4 AWG and larger wires and for other conditions when necessary.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Place all conductors of a given circuit (this includes phase wires, neutral (if any), and ground conductor) in the same raceway. If parallel phase and/or neutral wires are used, then place an equal number of phase and neutral conductors in same raceway or cable.

### **3.03 WIRING CONNECTIONS AND TERMINATIONS**

- A. Splice only in accessible junction boxes.
- B. Wire splices and taps shall be made firm, and adequate to carry the full current rating of the respective wire without soldering and without perceptible temperature rise.
- C. All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.
- D. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.
- E. Use mechanical or compression connectors for wire splices and taps, 8 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
- F. Thoroughly clean wires before installing lugs and connectors.
- G. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

### **3.04 FIELD QUALITY CONTROL**

- A. Field inspection and testing will be performed under provisions of Section 26 05 04.
- B. Additional testing as follows shall be performed if aluminum conductors are used:
- C. Equipment terminated with aluminum conductors shall be tested with a thermal imager and recorded.
- D. Conductors shall be closely checked for loose or poor connections, and for signs of overheating or corrosion.
- E. Test procedures shall meet NETA guidelines.
- F. Test results and report shall be provided to the engineer.
- G. Contractor shall correct all deficiencies reported in the test report.

### **3.05 WIRE COLOR**

- A. General:
  - 1. For wire sizes 10 AWG and smaller - Wire shall be colored as indicated below.
  - 2. For wire sizes 8 AWG and larger – Use colored wire, or identify wire with colored tape at all terminals, splices and boxes. Colors to be as indicated below.
  - 3. In existing facilities, use existing color scheme.
  - 4. All switch legs shall be the same color as their associated circuit. Traveler conductors run between 3 and 4 way switches shall be colored pink or purple.
- B. Neutral Conductors: White for 120/208V and 120/240V systems, Gray for 277/480V systems. Where there are two or more neutrals in one conduit, each shall be individually identified with a different stripe.
- C. Branch Circuit Conductors: Three or four wire home runs shall have each phase uniquely color coded.
- D. Feeder Circuit Conductors: Each phase shall be uniquely color coded.
- E. Ground Conductors: Green for 6 AWG and smaller. For 4 AWG and larger, identify with green colored wire, or with green tape at both ends and at all access points, such as panelboards, motor

starters, disconnects and junction boxes. When isolated grounds are required, contractor shall provide green with yellow tracer.

**3.06 BRANCH CIRCUITS**

- A. The use of single-phase, multi-wire branch circuits with a common neutral are not permitted. All branch circuits shall be furnished and installed with an individual accompanying neutral, sized the same as the phase conductors.

END OF SECTION



**SECTION 26 05 23**  
**CONTROL-VOLTAGE ELECTRICAL POWER CABLES**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes furnishing and installing required remote control and signal cabling.

**1.02 SECTION INCLUDES**

- A. General
- B. Manufacturers
- C. Remote Control and Signal Cable
- D. Wiring Connectors

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 26 05 00 – Common Work Results for Electrical
- C. Section 26 05 33 – Raceway and Boxes for Electrical Systems
- D. Section 26 05 53 – Identification for Electrical Systems

**1.04 SUBMITTALS**

- A. Submit product data: Provide for each cable assembly type.
- B. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

**1.05 REFERENCE STANDARDS**

- A. NFPA 70 - National Electrical Code

**1.06 PROJECT CONDITIONS**

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

**PART 2 – PRODUCTS**

**2.01 GENERAL**

- A. All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.
- B. All conductors shall be copper.
- C. Insulation shall have a 600 volt rating.
- D. All conductors must be suitable for the application intended. Conductors #12 and smaller may be solid or stranded with the following requirements or exceptions:
- E. All conductors terminated with crimp type devices must be stranded.
- F. Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods: e.g. stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back wired method.

## **2.02 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - 1. Alcan Products Corporation; Alcan Cable Division
  - 2. American Insulated Wire Corp.; a Leviton Company
  - 3. General Cable Corporation
  - 4. Senator Wire & Cable Company
  - 5. Southwire Company
  - 6. Houston Wire & Cable
  - 7. Belden

## **2.03 REMOTE CONTROL AND SIGNAL CABLE**

- A. Refer to Section 28 31 00 for requirements for cable to be used on fire alarm systems.
- B. All other systems cabling shall meet the requirements of NEC Article 725 and the following:
- C. Control Cable for Class 1 Remote Control and Signal Circuits: 600 volt insulation, individual conductors twisted together, shielded, and covered with an overall PVC jacket. Cable shall be Listed, temperature rated, and plenum or non-plenum rated for the application as required in the National Electrical Code.
- D. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits shall be constructed, Listed, temperature rated, and plenum or non-plenum rated for the application as required in the NEC Article 725.

## **2.04 WIRING CONNECTORS**

- A. Split Bolt Connectors: Not acceptable.
- B. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
- C. All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.

# **PART 3 – EXECUTION**

## **3.01 GENERAL WIRING METHODS**

- A. Low voltage control and signal cables shall be installed in conduit. However, they may be installed without conduit above accessible ceilings if the cable meets NEC requirements for the application, unless specified to be in conduit in other sections of the specifications. See requirements for free-air cabling installation below.
- B. Do not use wire smaller than 14 AWG for control wiring greater than 60 volts, or 18 AWG for voltages less than 60 volts, all sizes subject to NEC 725 requirements.
- C. Splice only in junction boxes.
- D. Identify wire per section 26 05 53.
- E. Neatly train and lace wiring inside boxes, and equipment.

## **3.02 WIRING INSTALLATION IN RACEWAYS**

- A. Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling conditions when necessary.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.

## **3.03 WIRING CONNECTIONS AND TERMINATIONS**

- A. Splice only in accessible junction boxes.
- B. All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.
- C. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.
- D. Thoroughly clean wires before installing lugs and connectors.
- E. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

**3.04 FIELD QUALITY CONTROL**

- A. Field inspection and testing will be performed under provisions of Section 26 05 04.

END OF SECTION

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**SECTION 26 05 26**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes grounding electrodes, connectors, equipment grounding conductors, bus and bonding.

**1.02 SECTION INCLUDES**

- A. Manufacturers
- B. Mechanical Connectors
- C. Compression Connectors
- D. Exothermic Connections
- E. Wire
- F. Bus

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 26 05 00 – Common Work Results for Electrical

**1.04 SUBMITTALS**

- A. Manufacturer's Instructions: Include instructions for preparation, installation and examination of exothermic connectors.

**1.05 REFERENCE STANDARDS**

- A. NFPA 70 - National Electrical Code.
- B. ANSI/IEEE 142 (Latest edition) - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

**1.06 REGULATORY REQUIREMENTS**

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

**PART 2 - PRODUCTS**

**2.01 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 by one of the following
  1. Burnoy
  2. Erico
  3. Schieder Sq. D
  4. Thomas Betts
  5. Panduit
  6. ILSCO.

**2.02 MECHANICAL CONNECTORS**

- A. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lockwashers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two bolt type.

- B. Split bolt connector types are NOT allowed. Exception: the use of split bolts is acceptable for grounding of wire-basket type cable tray, and for cable shields/straps of medium voltage cable.
- C. The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

### **2.03 COMPRESSION CONNECTORS**

- A. The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99% by IACS standards.
- B. The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.
- C. The installation of the connectors shall be made with a compression, tool and die system, as recommended by the manufacturer of the connectors.
- D. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compression tool settings.
- E. Each connector shall be factory filled with an oxide-inhibiting compound.

### **2.04 EXOTHERMIC CONNECTIONS**

- A. As manufactured by Cadweld or similar.

### **2.05 WIRE**

- A. Material: Stranded copper (aluminum not permitted).
- B. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used on the same facility.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. Install Products in accordance with manufacturer's instructions.
- B. Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over mechanical ground connections.
- C. Conductor Termination and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

### **3.02 LESS THAN 600 VOLT SYSTEM GROUNDING**

- A. Equipment Grounding Conductor: Provide separate, insulated equipment grounding conductor within each raceway. Terminate each end on suitable lug, bus, enclosure or bushing. Provide a ground wire from each device to the respective enclosure.
- B. Grounding Electrode Conductor: Provide separate, insulated grounding electrode conductor within PVC, sch 40, raceway from low voltage transformers to suitable grounding electrode connection.

### **3.03 FIELD QUALITY CONTROL**

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

END OF SECTION

**SECTION 26 05 29**  
**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes conduit and equipment supports, straps, clamps, steel channel, etc., and all required fastening hardware for supporting electrical work.

**1.02 SECTION INCLUDES**

- A. Support, Anchorage And Attachment Components
- B. Manufacturers

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 26 05 00 – Common Work Results for Electrical
- C. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
- D. Section 26 05 23 – Control Voltage Electrical Power Cables
- E. Section 26 05 26 – Grounding and Bonding for Electrical Systems
- F. Section 26 05 33 – Raceway and Boxes for Electrical Systems
- G. Section 26 12 16 – Dry-Type, Medium Voltage Transformers
- H. Section 26 22 00 – Low-Voltage Transformers
- I. Section 26 24 16 – Panelboards
- J. Section 26 27 26 – Wiring Devices
- K. Section 26 27 28 – Disconnect Switches
- L. Section 26 28 13 – Fuses
- M. Section 26 28 16 – Enclosed Switches and Circuit Breakers
- N. Section 26 29 00 – Low-Voltage Controllers
- O. Section 26 51 13 -Interior Lighting Fixtures, Lamps and Ballasts

**1.04 SUBMITTALS**

- A. Product Data: Provide data for support channel and equipment supports.

**1.05 QUALITY ASSURANCE**

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, “Structural Welding Code – Steel”.

**1.06 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

**1.07 COORDINATION**

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports and roof penetrations as specified in Division 07 Section “Roof Accessories”.

## **PART 2 - PRODUCTS**

### **2.01 SUPPORT, ANCHORAGE AND ATTACHMENT COMPONENTS**

- A. Support Channel: Steel, Galvanized, Enameled or other corrosion resistant.
- B. Hardware: Corrosion resistant.
- C. Minimum sized threaded rod for supports shall be 3/8" for trapezes and single conduits 1-1/4" and larger, and 1/4" for single conduits 1" and smaller.
- D. Conduit clamps, straps, supports, etc., shall be steel or malleable iron. One-hole straps shall be heavy duty type. All straps shall have steel or malleable backing plates when rigid steel conduit is installed on the interior or exterior surface of any exterior building wall.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Mechanical-Expansion Anchors: Insert-wedge-type, (zinc-coated) (stainless) steel, for use in hardened Portland cement concrete with tension, shear and pullout capacities appropriate for supported loads and building materials in which used.

### **2.02 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - 1. Allied Tube & Conduit
  - 2. Cooper B-Line, Inc.; a Division of Cooper Industries
  - 3. ERICO International Corporation
  - 4. GS Metals Corp.
  - 5. Thomas & Betts Corporation
  - 6. Unistrut; Tyco International, Ltd.
  - 7. Wesanco, Inc.
  - 8. Fabco Plastics Wholesale Limited
  - 9. Seasafe, Inc.
  - 10. Empire Tool & Manufacturing Co.
  - 11. Hilti, Inc.
  - 12. ITW Ramset/Red Head; a Division of Illinois Tool Works, Inc.
  - 13. MKT Fastening, LLC
  - 14. Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Fasten hanger rods, conduit clamps, outlet, junction and pull boxes to building structure using pre-cast insert system, preset inserts, beam clamps, expansion anchors, or spring steel clips (interior metal stud walls only).
- B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction. If nail-in anchors are used, they must be removable type anchors.
- C. Power-actuated fasteners and plastic wall anchors are not permitted.
- D. File and de-bur cut ends of support channel and spray paint with cold galvanized paint to prevent rusting.
- E. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not fasten to suspended ceiling grid system.
- F. Do not drill structural steel members unless approved by Engineer.
- G. Fabricate supports from galvanized structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.



- H. In wet locations, mechanical rooms and electrical rooms install free-standing electrical equipment on 3.5 inch (89 mm) concrete pads.
- I. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch (25 mm) off wall (7/8" Uni-strut or 3/4" painted, fire-retardant plywood is acceptable).
- J. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- K. Furnish and install all supports as required to fasten all electrical components required for the project, including free standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.

### **3.02 INSTALLATION OF FABRICATED METAL SUPPORTS**

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit and place miscellaneous metal supports accurately in location, alignment and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### **3.03 CONCRETE BASES**

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000 psi (20.7 MPa), 28 day compressive strength concrete. Concrete materials, reinforcement and placement requirements are specified in Division 03 Section "(Cast-in-Place Concrete) (Cast-in-Place Concrete – Limited Applications)".
- C. Anchor equipment to concrete base.
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instruction and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor bolt manufacturer's written instructions.

### **3.04 PAINTING**

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Division 09 (painting sections) (Section "High Performance Coating") for cleaning and touchup painting of field welds, bolted connections and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

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**SECTION 26 05 33**  
**RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid:
  - 1. The work under this section includes conduits, fittings, boxes, surface raceways, multi-outlet assemblies, auxiliary gutters, and wall duct for electrical systems including wall and ceiling outlet boxes, floor boxes, and junction boxes.

**1.02 SECTION INCLUDES**

- A. General
- B. Manufacturers
- C. Rigid Metal Conduit and Fittings
- D. PVC Coated Rigid Metal Conduit
- E. Intermediate Metal Conduit (IMC) and Fittings
- F. Electrical Metallic Tubing (EMT) and Fittings
- G. Flexible Metal Conduit and Fittings
- H. Liquidtight Flexible Metal Conduit and Fittings
- I. Electrical Nonmetallic Tubing (ENT) and Fittings
- J. Rigid Nonmetallic Conduit and Fittings
- K. Conduit Supports
- L. Outlet Boxes
- M. Floor Boxes
- N. Pull and Junction Boxes
- O. Hinged Cover Enclosures
- P. Cabinets

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 26 05 00 – Common Work Results for Electrical
- C. Section 26 05 26 – Grounding and Bonding for Electrical Systems
- D. Section 26 05 29 – Hangers and Supports for Electrical Systems
- E. Section 26 27 02 – Equipment Wiring Systems
- F. Section 26 27 26 – Wiring Devices
- G. Section 28 31 00 – Fire Detection and Alarm

**1.04 SUBMITTALS**

- A. Boxes - provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.
- B. Product data for conduit, wireways, fittings, floor boxes, hinged-cover enclosures or cabinets.

**1.05 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.

**PART 2 – PRODUCTS**

**2.01 GENERAL**

- A. All steel fittings and conduit bodies shall be galvanized.
- B. No cast metal, or split-gland type fittings permitted.
- C. Mogul-type condulets larger than 2 inch (50 mm) not permitted except as approved or detailed.

- D. All conduit covers must be fastened to the conduit body with screws and be of the same manufacture.
- E. Wireways, gutters and c-conduits shall not be used in lieu of pull boxes and conduits.
- F. All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

## **2.02 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. AFC Cable Systems, Inc.
  2. Alflex Inc.
  3. Allied Tube & Conduit; a Tyco International Ltd. Co
  4. Anamet Electrical, Inc.; Anaconda Metal Hose
  5. Armorcast Products Company
  6. Arnco Corporation
  7. CANTEX inc
  8. Carson Industries LLC
  9. CDR Systems Corporation
  10. CertainTeed Corp.; Pipe & Plastics Group
  11. Christy Concrete Products
  12. Condux International, Inc
  13. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
  14. EGS/Appleton Electric
  15. ElecSYS, Inc
  16. Electri-Flex Co.
  17. Erickson Electrical Equipment Company
  18. Hoffman
  19. Hubbell Incorporated; Killark Electric Manufacturing Co. Division
  20. Hubbell Incorporated; Quazite
  21. Lamson & Sessions; Carlon Electrical Products
  22. Manhattan/CDT/Cole-Flex
  23. Maverick Tube Corporation
  24. NewBasis
  25. Nordic Fiberglass, Inc.
  26. O-Z Gedney; a unit of General Signal
  27. RACO; a Hubbell Company
  28. Robroy Industries, Inc.; Enclosure Division
  29. Scott Fetzer Co.; Adalet Division
  30. Spring City Electrical Manufacturing Company
  31. Synertech Moulded Products, Inc.; a division of Oldcastle Precast
  32. Thomas & Betts Corporation
  33. Walker Systems, Inc.; Wiremold Company (The)
  34. Wheatland Tube Company
  35. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary

## **2.03 RIGID METAL CONDUIT AND FITTINGS**

- A. Conduit: Heavy wall, galvanized steel, schedule 40, threaded. ANSI C80.1
- B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

## **2.04 PVC COATED RIGID METAL CONDUIT**

- A. PVC Externally Coated Conduit: Rigid heavy wall, schedule 40, steel conduit with external 40 mil (0.1 mm) PVC coating. Conduit must be hot dipped galvanized inside and out including threads. The PVC coating bond to the galvanized steel conduit shall be stronger than the tensile strength of the coating itself.

- B. Fittings and Conduit Bodies: Threaded type, material to match conduit. PVC coated fittings and couplings shall have specially formed sleeves to tightly seal to conduit PVC coating. The sleeves shall extend beyond the fitting or coupling a distance equal to the pipe outside steel diameter or two inches (50 mm) whichever is greater.

**2.05 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS**

- A. Conduit: Galvanized steel, threaded. ANSI C80.6
- B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

**2.06 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS**

- A. Conduit: Steel, galvanized tubing. ANSI C80.3
- B. Fittings: All steel, set screw, concrete tight. No push-on or indenter types permitted.
- C. Conduit Bodies: All steel threaded conduit bodies.

**2.07 FLEXIBLE METAL CONDUIT AND FITTINGS**

- A. Conduit: steel, galvanized, spiral strip.
- B. Fittings and Conduit Bodies: All steel, galvanized, or malleable iron (except as allowed in specification 26 51 13).

**2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT AND FITTINGS**

- A. Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant jacket.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert on the end of the conduit inside the connector housing to seal the cut conduit end.

**2.09 ELECTRICAL NONMETALLIC TUBING (ENT) AND FITTINGS**

- A. Conduit: ENT (smurf tube), UL listed and NEC recognized. NEMA TC13
- B. Fittings: One piece quick connect fittings for 1/2 inch to 1 inch size and schedule 40 cemented fittings for larger size. When installed in concrete, fittings shall be suitable for damp locations and shall be concrete-tight, stub-ups and stub-downs kits shall meet manufacturer's recommendations.

**2.10 RIGID NONMETALLIC CONDUIT AND FITTINGS**

- A. Conduit: Schedule 40 PVC minimum, Listed, sunlight resistant, rated for 900 C conductors. NEMA TC2
- B. Fittings and Conduit Bodies: NEMA TC 2, Listed.

**2.11 CONDUIT SUPPORTS**

- A. See section 26 05 29.

**2.12 OUTLET BOXES**

- A. Sheet Metal Outlet Boxes and Device Boxes: galvanized steel, with stamped knockouts: NEMA OS1.
- B. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.
- C. Concrete Ceiling Boxes: Concrete type.
- D. Cast Boxes: Cast ferroalloy, or aluminum type deep type, gasketed cover, threaded hubs: NEMA FB1.
- E. Nonmetallic Outlet and Device Boxes: NEMA OS2.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS1.

**2.13 FLOOR BOXES**

- A. Floor Boxes for Installation in Cast-In-Place Concrete Floors: Full adjustable, cast iron. Nonmetallic

**2.14 PULL AND JUNCTION BOXES**

- A. Pull boxes and junction boxes shall be minimum 4 inch square (100 mm) by 2 1/8th inches (54 mm) deep for use with 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit or larger, pull and junction boxes shall be sized per NEC but not less than 4 11/16 inch square (117 mm).

- B. For telecommunication, fiber optic, security, and other low voltage cable installations the NEC box size requirements shall apply. All boxes, used on telecommunication, security, other low voltage and fiber optic systems with conduits of 1 1/4" and larger, shall be sized per the NEC conduit requirements. For determining box size, the conduit is the determining factor not the wire size.
- C. Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.
- D. Sheet Metal Boxes Larger Than 12 Inches (300 mm) in any dimension shall have a hinged cover or a chain installed between box and cover.
- E. Cast Metal Boxes for Outdoor and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as rain tight. Galvanized cast iron or aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- F. Fiberglass or Concrete Handholes with weatherproof cover of non-skid finish shall be used for underground installations. Provide traffic rate covers.
- G. Box extensions and adjacent boxes within 48" of each other are not allowed for the purpose of creating more wire capacity.
- H. Junction boxes 6" x 6" or larger size shall be without stamped knock-outs.
- I. Wireways shall not be used in lieu of junction boxes.

## **2.15 HINGED COVER ENCLOSURES**

- A. NEMA 250, Type 1, with continuous hinge cover with flush latch, unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures: Plastic, finished inside with radio frequency resistant paint.

## **2.16 CABINETS**

- A. NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
- B. Hinged door in front cover with flush latch and concealed hinges.
- C. Key latch to match panelboards.
- D. Metal barriers to separate wiring of different systems and voltage.
- E. Accessory feet where required for freestanding equipment.

## **PART 3 – EXECUTION**

### **3.01 CONDUIT SIZING, ARRANGEMENT AND SUPPORT**

- A. EMT is permitted to be used in sizes 4" (50 mm) and smaller for power and telecommunication systems. See CONDUIT INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduit.
- B. Size power conductor raceways for conductor type installed. Conduit size shall be 1/2 inch (13 mm) minimum except all homerun conduits shall be 3/4", or as specified elsewhere. Caution: Per the NEC, the allowable conductor ampacity is reduced when more than three current-carrying conductors are installed in a raceway. Contractor must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring system.
- C. Size conduit for all other wiring, including but not limited to data, control, security, fire alarm, telecommunications, signal, video, etc. shall be sized per number of conductors pulled and their cross-section. 40% fill shall be maximum for all new conduit fills.
- D. Arrange conduit to maintain headroom and present a neat appearance.
- E. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
- F. Maintain minimum 6 inch (150 mm) clearance between conduit and piping. Maintain 12 inch (300 mm) clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
- G. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped galvanized hangers.

- H. Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- I. Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for temporary conduit support during construction.
- J. Support and fasten metal conduit at a maximum of 8 feet (2.4 m) on center.
- K. Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, other conduits, etc., unless so approved or detailed.
- L. In general, all conduit shall be concealed except where noted on the drawings or approved by the Architect/Engineer. Contractor shall verify with Architect/Engineer all surface conduit installations except in mechanical rooms.
- M. Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel conduit bodies.
- N. For indoor conduits, no continuous conduit run shall exceed 100 feet (30 meters) without a junction box.
- O. All conduits installed in exposed areas shall be installed with a box offset before entering box.

### **3.02 CONDUIT INSTALLATION**

- A. Cut conduit square; de-burr cut ends.
- B. Conduit shall not be fastened to the corrugated metal roof deck.
- C. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- D. Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations.
- E. All conduit terminations (except for terminations into conduit bodies) shall use conduit hubs, or connectors with one locknut, or shall use double locknuts (one each side of box wall) and insulated bushing. Provide bushings for the ends of all conduit not terminated in box walls. Refer to Section 26 05 26 – Grounding and Bonding for Electrical Systems for grounding bushing requirements.
- F. Install no more than the equivalent of three 90 degree bends between boxes.
- G. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch (50 mm) size unless sweep elbows are required.
- H. Conduit shall be bent according to manufacturer's recommendations. Torches or open flame shall not be used to aid in bending of PVC conduit.
- I. Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and moisture.
- J. Provide 1/8 inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.
- K. Install expansion-deflection joints where conduit crosses building expansion joints. Note: expansion-deflection joints are not required where conduit crosses building control joints if the control joint does not act as an expansion joint. Install expansion fitting in PVC conduit runs as recommended by the manufacturer.
- L. Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain fittings at conduit low points.
- M. Where conduit passes between areas of differing temperatures such as into or out of cool rooms, freezers, unheated and heated spaces, buildings, etc., provide Listed conduit seals to prevent the passage of moisture and water vapor through the conduit.
- N. Route conduit through roof openings for piping and ductwork where possible.
- O. Conduit is not permitted in any slab topping of two inches (50 mm) or less.
- P. Ground and bond conduit under provisions of Section 26 05 26.
- Q. Maximum Size Conduit in Slabs Above Grade: 3/4 inch (19 mm). Do not route conduits to cross each other in slabs above grade.
- R. PVC conduit shall transition to galvanized rigid metal conduit before it enters a concrete pole base, foundation, wall (where exposed) or up through a concrete floor.
- S. Identify conduit under provisions of Section 26 05 53.
- T. All conduit installed underground (exterior to building) shall be buried a minimum of 24" below finished grade, whether or not the conduit is concrete encased.
- U. PVC conduit shall be cleaned with solvent, and dried before application of glue. The temperature rating of glue/cement shall match weather condition. Apply full even coat of cement/glue to entire

area that will be inserted into fitting. The entire installation shall meet manufacturer's recommendations.

### **3.03 CONDUIT INSTALLATION SCHEDULE**

- A. Conduit other than that specified below for specific applications shall not be used.
- B. Under Slab on Grade Installations: Schedule 40 PVC conduit.
- C. Exposed Outdoor Locations: Rigid steel conduit.
- D. Concealed in Concrete and Block Walls: Rigid steel conduit. Electrical metallic tubing. Schedule 40 PVC conduit. Electrical Nonmetallic Tubing (ENT).
- E. Below Concrete Slab (contact with earth): Rigid steel conduit. Schedule 40 PVC conduit. Electrical Nonmetallic Tubing (ENT).
- F. Concealed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
- G. Exposed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
- H. Motor and equipment connections: Flexible PVC coated metal conduit (all locations). Minimum length shall be one foot (300 mm), maximum length shall be three feet (900 mm). Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
- I. Light fixtures: Direct box or conduit connection for surface mounted and recessed fixtures. Flexible metal conduit from a J-box for recessed lay-in light fixtures. Conduit size shall be 3/8" (10 mm) minimum diameter and six foot (1.8 M) maximum length. Conduit length shall allow movement of fixture for maintenance purposes.

### **3.04 AUXILIARY GUTTERS (WIREWAYS) INSTALLATION**

- A. Bolt auxiliary gutter to wall using two-piece hangers or steel channels fastened to the wall or in self-supporting structure.
- B. Gasket each joint in oil-tight gutter.
- C. Mount rain-tight gutter in horizontal position only.
- D. Maintain grounding continuity between raceway components to provide a continuous grounding path under provisions of Section 26 05 26.

### **3.05 COORDINATION OF BOX LOCATIONS**

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets prior to rough-in.
- C. No outlet, junction, or pull boxes shall be located where it will be obstructed by other equipment, piping, lockers, benches, counters, etc.
- D. Boxes shall not be fastened to the metal roof deck.
- E. It shall be the Contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets with workmen installing other piping and equipment and to fit all electrical outlets to job conditions.
- F. In case of any question or argument over the location of an outlet, the Contractor shall refer the matter to the Architect/Engineer and install outlet as instructed by the Architect/Engineer.
- G. The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.
- H. Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 18 inch (450 mm) by 24 inch (600 mm) access doors.
- I. Locate and install to maintain headroom and to present a neat appearance.
- J. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

### **3.06 OUTLET BOX INSTALLATION**

- A. Do not install boxes back-to-back in walls. Provide minimum 6 inch (150 mm) separation, except provide minimum 24 inch (600 mm) separation in acoustic-rated walls.
- B. Power:



1. Recessed (1/4" maximum) outlet boxes in masonry, concrete or tile construction shall be minimum 4 inch square, with device rings. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.
- C. Low Voltage:
  1. Recessed (1/4" maximum) outlet boxes in masonry, concrete or tile construction shall be minimum 4 11/16 inch square, 2-1/8" deep. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.
- D. Provide knockout closures for unused openings.
- E. Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches (300 mm) of box.
- F. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide non-metallic barriers to separate wiring of different voltage systems.
- G. Install boxes in walls without damaging wall insulation.
- H. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- I. Ceiling outlets shall be 4 inch square, minimum 2-1/8 inch (54 mm) deep except that concrete boxes and plates will be approved where applicable. Position outlets to locate luminaires as shown on reflected ceiling plans.
- J. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches (150 mm) of recessed luminaire, to be accessible through luminaire ceiling opening.
- K. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- L. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- M. Provide cast ferroalloy or aluminum outlet boxes in exterior.
- N. Surface wall outlets shall be 4 inch (100 mm) square with raised covers for one and two gang requirements. For three gang or larger requirements, use gang boxes with non-overlapping covers.

### **3.07 PULL AND JUNCTION BOX INSTALLATION**

- A. Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install Owner approved access panels in non-accessible ceilings where boxes are installed. All boxes are to be readily-accessible.
- B. Support pull and junction boxes independent of conduit.

### **3.08 LOW VOLTAGE COMMUNICATIONS CONDUIT SYSTEM**

- A. Minimum size of conduit shall be 1" (one inch) for telecommunications (voice and data) including fiber optic installations, or where more than one type of cable or system is required to share a conduit.
- B. Minimum size of conduit shall be 3/4" for paging system, security access control and CCTV, nurse call and other low voltage systems such as alarms. Use 1/2-inch minimum flexible metallic conduit when installing raceway into door frames for security systems.
- C. Conduit provided for overhead projectors, audio-visual floor boxes and other audio-visual locations shall be minimum 1-1/4" or as indicated on drawings.
- D. Conduits shall be sized for a maximum 40% fill ratio.
- E. Provide flush two-gang box with single gang plaster ring for each communications outlet or as noted on drawings.
- F. Minimum size back box shall be 4" x 4" or double gang extra deep, except where noted differently. Provide 2" x 4" or single gang plaster ring to reduce opening for standard data outlet. Size of plaster ring may be adjusted (to 4" x 4") as required by outlet quantity.
- G. Use only couplings and fittings designed specifically for type of conduit or raceway shown. Provide insulated bushings on each fitting and raceway end.
- H. Provide raceways in walls from each back box stubbed into nearest accessible ceiling, corridor or access floor toward cable trays or toward Telecommunications Room. Ensure accessibility after other trades systems installation by extending raceway where necessary to an accessible location or near a

cable tray. Where back boxes are installed in laboratories or other areas where future access may be difficult, provide conduit out to nearest accessible hallway.

- I. Provide one conduit from each communications box. Horizontal conduit runs between wall boxes are not allowed.
- J. In areas where cable tray or j-hooks must cross an inaccessible ceiling, provide 4" EMT conduit in lieu of cable tray or j-hooks. For instance, where cables are supported by one 4" j-hook run prior to encountering an inaccessible ceiling, provide (1) 4" conduit to span the inaccessible area. Where 4"x12" cable tray is used, provide (4) 4" conduits to span the inaccessible area.
- K. Provide a 1/8 inch (3 mm) nylon pull string in each empty conduit longer than 60" to facilitate the installation of cables by the Owner or systems installers.
- L. Provide insulated bushings on exposed or cut end of every conduit.
- M. Conduit bends to be no less than 10 times the nominal outside diameter of conduit.
- N. No conduit run shall be longer than 100 linear feet without a pull box.
- O. No conduit run shall have more than two (2) 90 degree bends or total of 180 degrees of bend (including all offsets) without a pull box.
- P. Pull boxes shall not be used in lieu of bends. Pull boxes shall be installed in straight section of conduit.
- Q. Electrical LBs are not permitted unless manufactured for the use of communication cabling, having an internal bend radius appropriate for the cable size and application. Obtain engineer approval prior to installation.
- R. Provide conduit sleeves through walls as required by communications cable or as indicated on project documents. Where 1 to 4 communications cables are required, provide a 1" sleeve. For 5-20 cables are required, provide 2" sleeve. For 20-50 cables, provide 3" sleeve. Above 50 cables provide 4" sleeve. Sleeves shall extend min. 2" beyond wall on each side with plastic grommet or bushing to protect cable from abrasion. Conduit fill of sleeves may exceed 40%. All sleeves shall be fire stopped with UL listed system.
- S. Sleeves for cable access through walls or floors may not always be indicated on drawings. It is the contractor's responsibility to provide all sleeves in all locations as required by cable routing and as dictated by field conditions. Changes in a planned cable route during construction to reduce cable length or avoid obstructions shall not be a cause for change orders if additional sleeves are required.
- T. It is the contractor's responsibility to provide sleeves and support for communications cables for the entirety of the cable route, whether in conduit, cable tray or approved j-hooks (no bridle rings). The contractor shall review the reflected ceiling plans to determine the most appropriate method of support for any given area. The project documents may or may not indicate a method of support. If hard ceilings must be crossed, the contractor shall provide conduit through (above) the inaccessible areas into accessible areas, regardless whether the project documents indicate another method (or no method) of support. No change orders will be accepted to alter a means of support (for instance, a change from cable tray to conduit to cross an inaccessible ceiling or from cable tray to sleeves to shorten a cable route).
- U. Provide UL listed fire stop material between sleeve and wall. Provide UL listed fire stop system (material) or cap in unused conduit sleeves. Provide fire stop material in open portions of sleeves after communications cable has been installed. Fire stop system shall match or exceed the fire rating of the floor or wall which is penetrated by conduit and cable.
- V. If the services of a separate fire stop contractor are not secured for the project, the electrical or communications contractor is responsible to provide all fire stop systems and materials in conduit and sleeves which are used by the contractor. This includes all unused conduits in the immediate vicinity whether they are used on this project or not, as long as they are intended for future use by similar low-voltage systems cabling along the same route.

END OF SECTION

**SECTION 26 05 53**  
**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes the products and execution requirements relating to labeling of conduit, power, lighting, general wiring, signal, fire alarm, and telecommunications wire and cabling. Further, this section includes labeling of all terminations and related sub-systems, including but not limited to nameplates, stenciling, wire and cable marker labeling of all backbone fiber optic (inter-building, tie & riser) cables, terminating equipment and labeling of inner duct (fiber optic).

**1.02 SECTION INCLUDES**

- A. Manufacturers
- B. Identification Materials
- C. Power Raceway Identification Materials
- D. Armored and Metal-clad Cable Identification Materials
- E. Power and Control Cable Identification Materials
- F. Conductor Identification Materials
- G. Warning Labels and Signs
- H. Instruction Signs
- I. Equipment Identification Labels
- J. Cable Ties
- K. Miscellaneous Identification Products

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 01 91 13 – Commissioning Requirements
- C. Section 26 05 00 – Common Work Results for Electrical
- D. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
- E. Section 26 05 33 – Raceway and Boxes for Electrical Systems
- F. Section 26 24 16 – Panelboards
- G. Section 26 27 26 – Wiring Devices
- H. Section 26 27 28 – Disconnect Switches
- I. Section 26 28 16 – Enclosed Switches and Circuit Breakers

**1.04 SUBMITTALS**

- A. Include product data for each electrical identification product indicated.
- B. Include schedule for nameplates and stenciling.
- C. Prior to installation, the Contractor shall provide samples of all label types planned for the project. These samples shall include examples of the lettering to be used. Samples shall be mounted on 8 1/2” x 11” sheets annotated, explaining their purposed use.

**1.05 QUALITY ASSURANCE**

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFS 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers shall comply with UL 969.

## **1.06 COORDINATION**

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## **PART 2 – PRODUCTS**

### **2.01 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. Pipe/conduit identification
    - a. Pipe maker by Briman Industries, Inc.
    - b. Seton
    - c. Brady
    - d. Emedco
    - e. Graphic Products
    - f. Panduit
    - g. Thomas & Betts
  - 2. Conductor & Warning Identification
    - a. 3M
    - b. Panduit
    - c. Thomas & Betts
    - d. Brady

### **2.02 IDENTIFICATION MATERIALS**

- A. General:
  - 1. Labels: All labels shall be permanent, and machine generated. NO HANDWRITTEN OR NON-PERMANENT LABELS ARE ALLOWED. Exception: back side of device plates and junction boxes may use handwritten, legible labeling on box covers, unless specifically prohibited by other specification sections.
  - 2. Cable label size shall be appropriate for the conductor or cable size(s), outlet faceplate layout and patch panel design. All labels shall be self-laminating, white/transparent vinyl and be wrapped around the cable or sheath. Labels for power conductors (600V and lower) shall be cloth-type. Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminate over the full extent of the printed area of the label.
  - 3. Nameplates: Engraved three-layer laminated plastic, black letters on a white background. Emergency system (level 1 and level 2) shall use white letters on red background.
  - 4. Tape (phase identification only): Scotch #35 tape in appropriate colors for system voltage and phase.
  - 5. Adhesive type labels not permitted except for phase and wire identification. Machine generated adhesive labels shall be permitted for device plates, 4-11/16" and smaller junction boxes, Fire alarm and control devices.

### **2.03 POWER RACEWAY IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.

- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistance coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Tape and Stencil for Raceways Carrying Circuits More than 600 V: 4-inch (100 mm) wide black stripes on 10-inch (250 mm) centers diagonally over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stop stripes at legends.
- G. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

#### **2.04 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less.
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

#### **2.05 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Color coding shall be as noted in Section 26 05 19.

#### **2.06 CONDUCTOR IDENTIFICATION MATERIALS**

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, solid-colored acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identified and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- F. Color coding shall be as noted in Section 26 05 19.

#### **2.07 WARNING LABELS AND SIGNS**

- A. Comply with NFPA 70 and 28 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

- C. Baked-Enamel Warning Signs:
  1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
  2. ¼ inch (6.4 mm) grommets in corners for mounting.
  3. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Warning label and sign shall include, but are not limited to, the following legends:
  1. Multiple Power Source Warning: “DANGER ELECTRICAL SHOCK HAZARD – EQUIPMENT HAS MULTIPLE POWER SOURCES.”
  2. Workspace Clearance Warning: “WARNING – OSHA REGULATION – AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM).”

## 2.08 INSTRUCTION SIGNS

Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
  2. Punched or drilled for mechanical fasteners.
  3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).
  - C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

## 2.09 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.
- C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- E. Stenciled Legend: In nonfading, waterproof, [black] <Insert color> ink or paint. Minimum letter height shall be [1 inch (25 mm)] <Insert dimension>.

## 2.10 CABLE TIES

- A. General –Purpose Cable Ties: Fungus insert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon.
  1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73° F (23° C), According to ASTM D638: 12,000 psi (82.7 MPa).
  3. Temperature Range: Minus 50 to plus 185° F. (Minus 50 to plus 85° C).
  4. Color: Black except where used for color-coding.

## 2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## **PART 3 – EXECUTION**

### **3.01 GENERAL**

- A. Identification legend, colors of labels and color of raceway shall match facility standards. When no standards established the following systems shall be used.
- B. Where mixed voltages are used in one building (e.g. 4160 volt, 480 volt, 208 volt) each switch, switchboard, junction box, equipment, etc., on each system must be labeled for voltage in addition to other requirements listed herein.
- C. All branch circuit and power panels must be identified with the same identification legend used in circuit directory in main distribution center.
- D. Clean all surfaces before attaching labels with the label manufacturer's recommended cleaning agent.
- E. Install all labels firmly as recommended by the label manufacturer.
- F. Labels shall be installed plumb and neatly on all equipment.
- G. Install nameplates parallel to equipment lines.
- H. Secure nameplates to equipment fronts using screws, rivets or manufacturer approved adhesive or cement.
- I. Embossed tape will not be permitted for any application.

### **3.02 INSTALLATION**

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing of finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

### **3.03 IDENTIFICATION SCHEDULE**

- A. Accessible Raceway and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More than 30 A, and 120 V to ground: Install with self-adhesive vinyl tape applied in bands. Install labels at 30-foot (10-m) intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pullbox of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. Power.
- C. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - 1. Identify conductors, cables and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- D. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

- E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels Baked-enamel warning signs.
  - 1. Comply with 29 CFR 1910.145.
  - 2. Identify system voltage with black letters on an orange background.
  - 3. Apply to exterior of door, cover, or other access.
  - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Controls with external control power connections.

**3.04 JUNCTION AND PULLBOX IDENTIFICATION (WISCONSIN)**

- A. The following junction and pullboxes shall be identified utilizing spray painted covers:

<u>System</u>	<u>Color(s)</u>
Secondary Power – 480Y/277V	Brown
Secondary Power – 208Y/120V, 240/120V	White
Fire Alarm	Red

- B. Provide circuit numbers, and source panel designations for power wiring. Other system shall be identified as shown on details or approved shop drawings. Temperature control shall identify the source.

**3.05 POWER AND CONTROL WIRE IDENTIFICATION**

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.
- B. All wiring shall be labeled within 2 to 4 inches of terminations. Each end of a wire or cable shall be labeled as soon as it is terminated including wiring used for temporary purposes.

**3.06 WIRING DEVICE IDENTIFICATION**

- A. Wall switches, receptacles, occupancy sensors, device plates and box covers shall be identified with circuit numbers and source. In exposed areas, identifications should be made inside of device covers, unless directed otherwise. Use machine-generated labels, or neatly hand-written permanent marker.

**3.07 NAMEPLATE ENGRAVING**

- A. Provide nameplates of minimum letter height as scheduled below.
- B. A specific schedule may be included on the Contract Drawings, or specific schedules may be included in equipment Sections to which they apply; Panelboards, for example.
- C. Panelboards, Switchboards and Motor Control Centers: 1 inch (25 mm); identify equipment designation. 1/2 inch (13 mm); identify voltage rating, source and room location of the source.
- D. Equipment Enclosures: 1 inch (25 mm); identify equipment designation.
- E. Circuit Breakers, Switches, and Motor Starters in Panelboards or Switchboards or Motor Control Centers: 1/2 inch (13 mm); identify circuit and load served, including location.
- F. Disconnect Switches and Motor Starters: 1/2 inch (13 mm); identify source and load served.
- G. Transformers: 1 inch (25 mm); identify equipment designation. 1/2 inch (13 mm); identify primary and secondary voltages, primary source, and secondary load and location.
- H. Junction boxes: 1 inch (25 mm); identify system source(s) and load(s) served. Junction boxes may be neatly identified using a permanent marker.

END OF SECTION



**SECTION 26 05 73**  
**SHORT CIRCUIT/COORDINATION STUDY AND ARC FLASH HAZARD STUDY**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The electrical contractor shall retain the services of an independent third party firm to perform a short circuit/coordination study and arc flash hazard study as described herein.
- B. The preliminary studies shall be submitted to the Design Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture. If formal completion of the studies may cause delay in equipment manufacture, approval from the Engineer may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory. The preliminary studies shall be revised and final study resubmitted following installation of conductors and equipment.
- C. The studies shall include all portions of the electrical distribution system from the normal power source or sources, and emergency / standby sources, down to and including the smallest circuit breaker in the distribution system (for short circuit calculations). Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.
- D. The firm should be currently involved in high- and low-voltage power system evaluation. The study shall be performed, stamped and signed by a registered professional engineer in the State of Wisconsin. Credentials of the individual(s) performing the study and background of the firm shall be submitted to the Design Engineer for approval prior to start of the work. A minimum of five (5) years' experience in power system analysis is required for the individual in charge of the project.
- E. The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.
- F. The study and assessment shall be performed based on SKM's systems analysis and PowerTool for Windows (PTW) software program.

**1.02 SECTION INCLUDES**

- A. Short Circuit and Coordination Study
- B. Field Settings
- C. Arc Flash Hazard Study

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 26 11 16 – Secondary Unit Substations
- C. Section 26 14 13 - Switchboards
- D. Section 26 24 16 – Panelboards
- E. Section 26 27 28 – Disconnect Switches
- F. Section 26 28 16 – Enclosed Switches and Circuit Breakers
- G. Section 26 29 00 – Low-Voltage Controllers

**1.04 SUBMITTALS**

- A. THIRD PARTY QUALIFICATIONS
  - 1. Submit qualifications of individual(s) who will perform the work to Design Engineer for approval prior to commencement of the studies. Study shall be sealed by [IL][WI][State] professional engineer.
- B. DRAFT REPORT
  - 1. Submit a draft of the preliminary study to Design Engineer for review prior to equipment shop drawings submittals. Make all additions or changes as required by the reviewer.
- C. FINAL STUDY REPORT
  - 1. Provide studies in conjunction with equipment submittals and after installation of conductors and equipment to verify equipment ratings required.
  - 2. The results of the power system study shall be summarized in a final report. Six (6) bound copies of the final report shall be submitted. Provide two (2) copies in PDF format of the study, so that it can be

more easily stored and shared. Also, provide 2 copies (on CD) of the report in MS word, and 2 copies (on CD) of the one-line diagram in CAD format.

- a. The report shall include the following sections:
  - b. Overview/executive summary/recommendations
  - c. Short Circuit Study
    - 1) SC-1 Purpose
    - 2) SC-2 Explanation of Data
    - 3) SC-3 Assumptions
    - 4) SC-4 Analysis of Results
    - 5) SC-5 Recommendations
    - 6) SC-6 DAPPER Fault Analysis Input Report
  - d. Protective Device Coordination Study
    - 1) PDC-1 Purpose
    - 2) PDC-2 Explanation of Data
    - 3) PDC-3 Assumptions
    - 4) PDC-4 Analysis of Results
    - 5) PDC-5 Recommendations (Including NEC 700-27 Requirement)
    - 6) PDC-6 CAPTOR Results
    - 7) PDC-7 Protective device settings table
    - 8) PDC-8 Time-Current Coordination Graphs
  - e. Arc Flash Study
    - 1) ARC-1 Purpose
    - 2) ARC-2 Explanation of Data
    - 3) ARC-3 Assumptions
    - 4) ARC-4 Analysis of Results
    - 5) ARC-5 Recommendations
    - 6) ARC-6 SKM Arc Flash Evaluation Report
  - f. Prioritized Recommendations and Conclusions
  - g. Appendices
    - 1) APP-1 DAPPER One-line Diagrams
    - 2) APP-2 AutoCAD One-line Diagrams
    - 3) APP-3 SKM Protective Device Summaries
    - 4) APP-4 Reference Data
    - 5) APP-5 Sample Work Permit Form
    - 6) APP-6 Copy of Warning Labels, including study date
- D. The above sections shall include the following items in detail:
1. Obtain available fault current from the local utility company.
  2. Short circuit studies shall evaluate the available fault current at each bus (each change of impedance), including all three-phase motors.
  3. Coordination study shall provide recommendations for relay settings, breaker settings, and motor protection settings.
  4. Coordination study shall provide recommendations for improving the coordination with proper upgrading of protective device type or frame size and/or load distribution, as well as ground fault requirements.
  5. Arc flash values for two normal cases to define the highest values (low short circuit and high short circuit).
  6. Arc flash values for two maintenance cases, which define the arc flash values available at the equipment that would be available if the instantaneous trip of the upstream circuit breaker is set at a minimum value. This is recommended if someone has to work on live equipment.
  7. Arc Flash Hazard Methodology Analysis Results and Recommendations shall include the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels. Arc Flash labeling section showing types of labels to be provided. Section shall contain descriptive information as well as typical label images.
  8. IEEE standard one-line diagram with equipment evaluation and circuit breaker setting forms that clearly define the system data and are easy to interpret. One-line system diagram that shall be

- computer generated and shall clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.
9. Recommendations to reduce the arc flash incident energy in all areas that require class2 and higher PPE.
  10. Prioritized report summarizing all recommendations from this study. This shall include observed NEC code violations and their corrective action.
  11. The contractor shall provide a one-line diagram that meets IEEE/ANSI standard 141, mounted on 24" x 36" (minimum) Styrofoam backboard. This one-line diagram shall be mounted in each electrical room.

#### **1.05 REFERENCE STANDARDS**

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
  2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
  3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
  4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
  5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
  6. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):
  1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
  2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
  3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
  4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
- C. The National Fire Protection Association (NFPA)
  1. NFPA 70 -National Electrical Code, latest edition
  2. NFPA 70E – Standard for Electrical Safety in the Workplace

#### **1.06 QUALITY ASSURANCE**

- A. Software algorithms shall comply with requirements of standards and guides specified in this section. Manual calculations are not acceptable.
- B. Coordination Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  1. Professional engineer, licensed in the state where project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 242 for short circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

#### **1.07 DATA COLLECTION FOR THE STUDY**

- A. The contractor shall provide the required data for preparation of the studies. The engineer performing the system studies shall furnish the contractor with a listing of the required data immediately after award of the contract.
- B. The contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture.
- C. Source combination may include present and future motors and generators.

- D. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.
- E. If applicable, include fault contribution of existing motors in the study. The contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

## **PART 2 – PRODUCTS**

### **NOT USED**

## **PART 3 – EXECUTION**

### **3.01 SHORT CIRCUIT AND COORDINATION STUDY**

- A. The short circuit, coordination, and arc flash hazard studies shall be performed using SKM Dapper, Captor and PowerTool for Windows software packages. In the short circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, and recommendations. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low voltage switchgear lineup, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault currents.
- B. In the protective device coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
- C. Include on the time-curve sheets power company relay and fuse characteristics, system medium-voltage equipment relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards.
- D. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load and 150, 400, or 600 percent currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.
- E. Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Where the primary device characteristic is not within the transformer characteristics, show a transformer damage curve. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults. Separate medium-voltage relay characteristic curves from curves for other devices by at least a 0.4-second time margin.
- F. Include complete fault calculations as specified herein for each proposed and ultimate source combination. Note that source combinations may include present and future supply circuits, large motors, or generators as noted on drawing one-lines.
- G. Utilize equipment load data for the study obtained by the Contractor from contract documents, including contract addendums issued prior to bid openings.

- H. Include fault contribution of all motors in the study. Notify the Engineer in writing of circuit protective devices not properly rated for fault conditions.
- I. Provide settings for the chiller motor starters or obtain from the mechanical contractor, include in the study package, and comment.
- J. When an emergency generator is provided, include phase and ground coordination of the generator protective devices, to meet NEC 700.27 requirements. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.
- K. Evaluate proper operation of the ground relays in 4-wire distributions with more than one main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.
- L. For motor control circuits, show the MCC full-load current plus symmetrical and asymmetrical of the largest motor starting current to ensure protective devices will not trip major or group operation.

### **3.02 FIELD SETTINGS AND ADJUSTMENT**

- A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study, protective device coordination study and arc flash hazard study.
- B. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.

### **3.03 ARC FLASH HAZARD STUDY**

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2009, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis (Section 2.03) and the protective device time-current coordination analysis (Section 2.04)
- B. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (panelboards) where work could be performed on energized parts.
- C. Circuits 240V or less fed by single transformer rated less than 125 kVA may be omitted from the computer model and will be assumed to have a hazard risk category 0 per NFPA 70E.
- D. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.
- G. The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
- H. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:
  - 1. Fault contribution from induction motors should not be considered beyond 5 cycles.
- I. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear; and shall be based on a device located

upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.

- J. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- K. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- L. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
- M. Provide the following:
  - 1. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal-protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
  - 2. The Arc-Flash Hazard Analysis shall report incident energy values based on recommended device settings for equipment within the scope of the study.
  - 3. The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.

### **3.02. ARC FLASH LABELS**

- A. Engineering Services shall provide a 4.0 in. x 4.0 in. Brady thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. The labels shall be designed according to the following standards:
  - 1. UL969 – Standard for Marking and Labeling Systems
  - 2. ANSI Z535.4 – Product Safety Signs and Labels
  - 3. NFPA 70 (National Electric Code) – Article 110.16
- C. The label shall include the following information:
  - 1. System Voltage
  - 2. Flash protection boundary
  - 3. Personal Protective Equipment category
  - 4. Arc Flash Incident energy value (cal/cm<sup>2</sup>)
  - 5. Limited, restricted, and prohibited Approach Boundaries
  - 6. Study report number and issue date
- D. Labels shall be printed by a thermal transfer type printer, with no field markings.
- E. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:
  - 1. Floor Standing Equipment - Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.
  - 2. Wall Mounted Equipment – Labels shall be provided on the front cover or a nearby adjacent surface, depending upon equipment configuration.
  - 3. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.
- F. Labels shall be field installed by the Contractor. The technician providing the installation shall have completed an 8-Hour instructor led Electrical Safety Training Course which includes NFPA 70E material including the selection of personal protective equipment.

END OF SECTION

**SECTION 26 22 00**  
**LOW-VOLTAGE TRANSFORMERS**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes dry type general purpose two winding transformers and dry type isolation transformers rated 600 volt or less.

**1.02 SECTION INCLUDES**

- A. Manufacturers
- B. Dry-Type General Purpose Two Winding Transformers

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 05 00 – Common Work Results for Electrical
- C. Section 26 05 26 Grounding and Bonding for Electrical Systems
- D. Section 26 05 29 Hangers and Supports for Electrical Systems

**1.04 SUBMITTALS**

- A. Include outline and support point dimensions of enclosures and accessories, minimum required clearances, unit weight, voltage, kVA, and impedance ratings and characteristics, loss data, efficiency and 25, 50, 75 and 100 percent load, sound levels, tap configurations, wiring diagrams, insulation system type, and rated temperature rise.

**1.05 REFERENCE STANDARDS**

- A. U.S. Department of Energy (DOE) CFR Title 10, Chapter II, Subchapter D, Part 431, Subpart K - Distribution Transformers.

**1.06 OPERATING AND MAINTENANCE DATA**

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

**1.07 DELIVERY, STORAGE AND HANDLING**

- A. Store and protect equipment in a dry location with uniform temperature. Cover ventilating openings to keep out dust.
- B. Handle transformers using only from lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet or snow if handled in inclement weather.
- C. Temporary heating: Apply temporary heat according to the manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

**1.08 COORDINATION**

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. General Electric Company
3. Siemens Energy & Automation, Inc.
4. Square D; Schneider Electric

**2.02 DRY TYPE GENERAL PURPOSE TWO WINDING TRANSFORMERS**

- A. Dry Type General Purpose Transformers: Factory assembled, air cooled, dry type general purpose two winding transformers; kVA ratings as shown on the Drawings.
- B. Transformers shall meet the U.S. Department of Energy (DOE) minimum efficiency levels for distribution transformers as mandated in CFR Title 10, Chapter II, Subchapter D, Part 431, Subpart K - Distribution Transformers..
- C. Transformer losses shall conform to NEMA TP-1 requirements.
- D. Insulation system shall be rated at 220 degrees C.
- E. Winding temperature rise shall be rated at 150 degrees C above a 40 degree C ambient.
- F. Case temperature shall not exceed 50 degrees C rise above a 40 degrees C ambient at its warmest point.
- G. Winding Taps, Transformers 15 KVA and Larger: Four 2-1/2 percent taps, two above and two below rated voltage, full capacity taps on primary winding.
- H. Sound Levels: Maximum sound levels are as follows:

KVA Rating	Sound Level
15-50	45 dB
51-150	50 dB

- I. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap sized to meet NEMA and UL standards.
- J. Coil Material and Conductors: Coil material: Aluminum continuous windings with termination pads brazed or welded.
- K. Isolate core and coil from enclosure using vibration absorbing mounts.
- L. Enclosure: NEMA Type 1. Provide lifting eyes or brackets. Finish color shall be gray.
- M. Nameplate: Include transformer connection data.
- N. Mounting: Transformers 75 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 KVA shall be suitable for floor or trapeze mounting.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

- A. Set transformer plumb and level.
- B. Use flexible conduit, 2 ft. (0.6 m) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure. Construct concrete bases and anchor floor-mounting transformers according to manufacturer’s written instructions.
- D. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems.
- E. Provide sufficient space around transformer for cooling as recommended by the manufacturer.
- F. Verify that ground connections are in place and requirements in Division 26 Section “Grounding and Bonding for Electrical Systems” have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- G. Identify all equipment and overcurrent devices as required by Section 26 05 53.



**3.02 CLEANING**

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

**3.03 ARC FLASH & SHOCK HAZARD LABELING**

- A. Provide proper labeling of all equipment for arc flash and shock hazards as recommended in the coordination study provided by manufacturer or as directed by A/E.

**3.04 FIELD QUALITY CONTROL**

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure primary and secondary voltages and make appropriate tap adjustments within 2-1/2% of the normal operating load after the building is in full operation.

**3.05 TRAINING**

- A. See Section 26 05 00 for general training requirements.
- B. In addition to the training provided in Section 26 05 00, provide an additional 1 hour of training for each type of transformer provided on the project.

END OF SECTION

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**SECTION 26 24 16  
PANELBOARDS**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes branch circuit panelboards.

**1.02 SECTION INCLUDES**

- A. Branch Circuit Panelboards

**1.03 RELATED WORK**

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

**1.04 SUBMITTALS**

- A. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, and circuit breaker arrangement and sizes.

**1.05 OPERATION AND MAINTENANCE DATA**

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

**1.06 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, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and location of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Existing electrical service interruption shall comply with Section 26 05 02 Electrical Demolition for Remodeling.
- D. Distribution panels and branch circuit panelboards manufacturer shall be the same manufacturer as switchboards, motor starters and disconnect switches.

**1.07 SPARE PARTS**

- A. Keys: Furnish 2 keys for each panelboard to Owner.

**PART 2 – PRODUCTS**

**2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Products.
  2. General Electric Company
  3. Siemens Energy & Automation, Inc.
  4. Square D; Schneider Electric

**2.02 BRANCH CIRCUIT PANELBOARDS**

- A. Lighting and Appliance Branch Circuit Panelboards: Circuit breaker type.
- B. Enclosure: Type 1. Minimum cabinet size: 5-3/4 inches (144 mm) deep; 20 inches (508 mm) wide with 5" minimum gutter space top and bottom. Constructed of galvanized code gauge steel. Panel enclosure (back box) shall be of non-stamped type (without KO's) to avoid concentric break out problem.

- C. Provide surface cabinet front with concealed trim clamps, concealed hinge and flush cylinder lock all keyed alike. Front cover shall be hinged to allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.
- D. Provide metal directory holders with clear plastic covers.
- E. Provide panelboards with copper bus (phase buses, bus fingers, etc.), ratings as scheduled on Drawings. Provide ground bars in all panelboards. Neutral and ground bars can be dual rated ALCU9. All spaces shall have bus fully extended and drilled for the future installation of breakers.
- F. Minimum System (i.e. individual component) Short Circuit Rating: As shown on the Drawings.
- G. Molded Case Circuit Breakers:
  - 1. Bolt-on type thermal magnetic trip circuit breakers.
  - 2. Provide UL Class A ground fault interrupter circuit breakers where shown on Drawings.
  - 3. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
  - 4. 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 250A and larger.
  - 5. Accessories:
    - a. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - b. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
- H. Do not use tandem circuit breakers.
- I. Circuit breakers shall be bolt-on type with common trip handle for all poles. No handle ties of any sort will be permitted.
- J. All of the panelboards provided under this section shall be by the same manufacturer.

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. See section 26 05 29 for support requirements.
- B. Install panelboards plumb with wall finishes.
- C. Height: 6 ft. (2 m) to top or 6 ft. to center of breaker handle.
- D. Install a crimp type stud termination to stranded conductor when terminating on circuit breakers without a captive assembly rated for terminating stranded conductors.
- E. Provide filler plates for unused spaces in panelboards.
- F. See section 26 05 53 for identification requirements. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- G. Stub three (3) empty ¾" conduits to accessible location above ceiling or below floor out of each recessed panelboard. Cap these conduits to prevent material from entering them.

### **3.02 FIELD QUALITY CONTROL**

- A. If aluminum conductors size #1/0 and larger (per Section 26 05 19) are to be used as panelboard feeders, it is the responsibility of the contractor to provide panelboards with adequate wire bending space to accommodate the aluminum conductors and terminators to meet allowable code requirements. The Contractor shall circuit the panelboards as shown on the drawings. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 10 percent, rearrange circuits in the panelboard to balance the phase loads within 10 percent.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections.

### **3.03 ADJUSTING**

- A. Adjust all operating mechanisms for free mechanical movement.
- B. Adjust trip and time delay settings to values as recommended in coordination study provided by manufacturer or as instructed by the A/E. Include a copy of the coordination study and recommended circuit breaker set points in the O & M Manual.

**3.04 TRAINING**

- A. See Section 26 05 00 for general training requirements.
- B. In addition to the training provided in Section 26 05 00, provide an additional 1 hour of training for each type of panelboard provided on the project.

END OF SECTION

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**SECTION 26 27 02  
EQUIPMENT WIRING SYSTEMS**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes electrical connections to equipment specified under other Divisions and/or Sections, or furnished by Owner, including, but not limited to:
  - 1. HVAC motors and panels
  - 2. Plumbing motors and panels
  - 3. Kitchen Equipment

**1.02 SECTION INCLUDES**

- A. Cords and Caps
- B. Other Products

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

**1.04 SUBMITTALS**

- A. Product Data: Provide data for cord and wiring devices.

**1.05 COORDINATION**

- A. Coordinate all equipment requirements with the various contractors and the Owner. Review the complete set of drawings and specifications to determine the extent of wiring, starters, devices, etc., required.

**PART 2 – PRODUCTS**

**2.01 CORDS AND CAPS**

- A. Straight-blade Attachment Plug: NEMA WD 1.
- B. Locking-blade Attachment Plug: NEMA WD 5.
- C. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
- D. Cord Construction: Oil-resistant thermoset insulated multiconductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.
- E. Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

**2.02 OTHER PRODUCTS**

- A. Refer to related sections for other product requirements.

**PART 3 – EXECUTION**

**3.01 INSPECTION**

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

**3.02 PREPARATION**

- A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

**3.03 INSTALLATION**

- A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.

- B. Make conduit connections to equipment using flexible PVC-coated metal conduit.
- C. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
- D. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.
- E. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.
- F. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.
- G. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

### **3.04 HVAC AND PLUMBING CONNECTIONS**

- A. Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source through starters and disconnects to motors or to packaged control panels. Packaged control panels may include disconnects and starters and overcurrent protection. Provide all wiring between packaged control panels and motors.
- B. Each motor terminal box shall be connected with a minimum 12", maximum 36" piece of flexible PVC-coated metal conduit to a fixed junction box. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
- C. Check for proper rotation of each motor.

### **3.05 KITCHEN EQUIPMENT CONNECTIONS**

- A. Check loose equipment delivered to job by equipment installer against approved shop drawings or other required Drawings. Loose electrical equipment including disconnects, starters, thermostats, controls, local and remote switches shall be furnished by equipment contractor and installed by electrical contractor.
- B. Equipment contractor will receive all equipment and position in place.
- C. Equipment contractor shall provide dimensioned equipment layouts, detailed shop drawings of equipment showing locations and method of installing loose equipment and making final connections, and wiring and control diagrams.
- D. Electrical Contractor shall rough in for kitchen equipment only from approved kitchen equipment shop drawings.
- E. Rough in location shall be within three inches of equipment. If direct connection is required, use liquidtight flexible conduit. If receptacle connection is required, verify proper receptacle configuration with equipment installer.
- F. Final connections shall include extension of all service to each piece of equipment. All labor and material required to completely connect the equipment ready to operate shall be included in the final connections. All control wiring not integral with equipment shall be included.
- G. Equipment contractor shall provide services of their representatives and or equipment manufacturer's representative at appropriate stage of construction to answer the Contractor's questions concerning the final connections.
- H. For kitchen exhaust hoods provide all required power and control wiring. This may include (but is not limited to) the following:
  - 1. Provide switch in hood and branch circuit for integral light fixtures.
  - 2. Provide pushbutton switch or manual starter for exhaust fan.
  - 3. Provide branch circuit for fire suppression system. Wire automatic heat detectors or manual station so, when activated, valve of dry chemical bottle opens, gas solenoid valve shuts down, all dampers close, and make-up fans shut down, electrical power contactor opens (integral in equipment), and building fire alarm system is activated. Provide all required wiring conduit and final connections. Refer to wiring diagrams supplied with equipment.

### **3.06 EQUIPMENT CONNECTION SCHEDULE**

- A. As indicated on the drawings.

END OF SECTION



**SECTION 26 27 26  
WIRING DEVICES**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes wall switches, receptacles, occupancy sensors, wall dimmers, device plates and box covers, poke-through service fittings, access floor boxes, photo cells and time clocks.

**1.02 SECTION INCLUDES**

- A. Wall Switches
- B. Receptacles
- C. Kitchen Cord Drop Assemblies
- D. Occupancy Sensors
- E. Device Plates and Box Covers

**1.03 RELATED WORK**

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

**1.04 SUBMITTALS**

- A. Provide product data showing model numbers, configurations, finishes, dimensions, and manufacturer's instructions.
- B. For occupancy sensor shop drawings, the manufacturer's actual layout of occupancy sensors and the wiring diagrams shall be provided.
- C. Test Reports

**1.05 OPERATION AND MAINTENANCE DATA**

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

**PART 2 – PRODUCTS**

**2.01 WALL SWITCHES**

- A. Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: Heavy duty use toggle switch, rated 20 amperes and 120/277 volts AC. Switches shall be UL20 Listed and meet Federal Specification WS-896. All switches shall be heavy duty Specification Grade with separate green ground screw. Provide single pole, three way, four way and other configurations as noted on the drawings.
- B. All switches shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG. Switches shall be Leviton model 1221-S, Hubbell model CS1221, Pass & Seymour model CSB20, Cooper model CSB120, or approved equal.
- C. Handle: Ivory made of nylon or high impact resistant material.

**2.02 RECEPTACLES**

- A. Duplex Convenience and Straight-blade Receptacles: NEMA Type 5-20R, ivory nylon or high impact resistant face. Receptacles shall be UL498 Listed, comply with NEMA WD1, NEMA WD6 configuration 5-20R and meet Federal Specification WC-596. All duplex receptacles shall be heavy duty Specification Grade, 20 amp rated. All receptacles shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw. Receptacles shall be Leviton model 5362-S, Hubbell model CR5362, Pass & Seymour model CRB5362, Pass & Seymour model PT5362 with 90° connector, Cooper model 5362, or approved equal.
- B. Generally, all receptacles shall be duplex convenience type unless otherwise noted.

- C. All receptacles installed in outdoor locations, in garages, within 6 feet of the outside edge of sinks, and in other damp or wet locations shall be GFCI type.
- D. GFCI Receptacles: Duplex convenience straight-blade feed through receptacle, Specification Grade, with integral ground fault current interrupter meeting the requirements of UL standard 943 Class A and include indicator light that is lighted when device is tripped. Device shall comply with NEMA WD1, NEMA WD6, and UL standard 498. GFCI receptacles shall be Leviton model 8899, Hubbell model GRF5352, Pass & Seymour model 2095, Cooper model VGF20 or approved equal.
- E. Locking-Blade Receptacles: As indicated on drawings.
- F. Specific-use Receptacle Configuration: As indicated on drawings.

### **2.03 KITCHEN CORD DROP ASSEMBLIES**

- A. A. General
  - 1. 1. Receptacle devices noted as cord drops on the plans shall be a pre-wired portable outlet box assembly with (2) 20A GFCI duplex receptacle in common box.
    - a. UL Listed, Damp Location
    - b. Single Circuit
    - c. NEMA 5-20 Devices
    - d. 12/3 SO Cord
    - e. Back to back device mounting
    - f. Hardwired connection at ceiling by way of junction box with cord compression fitting and strain relief.
    - g. Strain relief at ceiling plate and receptacle box.
    - h. Black cord, black box.

### **2.04 OCCUPANCY SENSORS**

- A. All occupancy sensors shall be hardwired type; battery type shall not be permitted.
- B. Wall Mounted (Wall Switch Type)
  - 1. The sensor shall use either passive infrared or, if dual technology, passive infrared and passive acoustic sensing, or passive infrared and ultrasonic, for detecting room occupancy. The unit shall fit in/on a standard single gang switch box.
  - 2. Rated capacity: 600 watts minimum at 120 volts, 60 Hz; 1000 watts minimum at 277 volts, 60 Hz
  - 3. Sensitivity shall be user adjustable or self-adjusting type.
  - 4. The delay timer shall be adjusted within a range of 6 to 30 minutes by the contractor in the field. The sensor shall have a test mode for performance testing.
  - 5. The off switch shall have manual override for positive off and automatic on.
  - 6. The test LED shall indicate motion.
  - 7. The area of coverage shall be approximately 180 degrees by 35-40 feet.
  - 8. The unit shall have a five year warranty.
  - 9. See drawings for actual type of sensor.
- C. Ceiling Mounted
  - 1. The sensor shall use either passive infrared or, if dual technology, passive infrared and passive acoustic sensing, or passive infrared and ultrasonic, for detecting room occupancy. The unit shall fit in/on a standard octagon box. All ceiling mounted sensors shall be installed to a box with ring and box support.
  - 2. Rated capacity shall be 20 amps at 120 or 277 volts, for fluorescent lamps. Provide power pack as required for low voltage sensors.
  - 3. Sensitivity shall be user adjustable or self-adjusting type.
  - 4. The delay timer shall be adjusted within a range of 6 to 30 minutes by the contractor in the field. The sensor shall have a test mode for performance testing.
  - 5. The coverage area shall be 360 degrees by approximately 15 feet radius when mounted at 9 foot height. The sensor shall have provisions, such as masking, to block out problem areas.
  - 6. Test LED to indicate motion.
  - 7. The unit shall have a five year warranty.
  - 8. See drawings for actual type of sensor.

### **2.05 DEVICE PLATES AND BOX COVERS**

- A. Decorative Cover Plate: 302/304 smooth stainless steel. Plate securing screws shall be metal with color to match plate finish.
- B. Weatherproof Cover Plate: Gasketed metal with hinged device covers.
- C. While in Use Cover: UL Listed outdoor die-cast hinged cover with integral lock tab.
- D. Surface Cover Plate: Raised galvanized steel.

## **2.06 PHOTO CELLS**

- A. The controller shall be rated 2000 watts tungsten at 120, 240 or 277 volts. The cell shall be cadmium sulfide, 1" diameter.
- B. The enclosure shall be die cast zinc, gasketed for maximum weather proofing.
- C. The enclosure shall include the positioning lug on the top of the enclosure.
- D. The unit shall have a delay of up to two minutes to prevent false switching. ON/Off adjustment shall be done by moving a light selector with a range from 2 to 50 foot-candles.
- E. Mounting shall be for a 1/2" conduit nipple.
- F. The unit shall have a 5 year warranty.
- G. The contacts shall be SPST normally closed.
- H. The operational temperature range shall be -40 to 140 degrees F(-40 to +60 degrees C).

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. Install wall switches 48 inches above floor, OFF position down.
- B. Install convenience receptacles 18 inches above floor, 12 inches above counters, grounding pole on bottom.
- C. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- D. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- E. Install devices and wall plates flush and level.
- F. Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-grounding receptacles using mounting screws as bonding means are not approved.
- G. Oversized or extra deep coverplates not acceptable. Repair wall finishes and remount outlet box when standard device plates do not fit flush or do not cover rough wall opening.
- H. Coordination with Other Trades:
  - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including, painting, is complete.
- I. Conductors:
  - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall meet provisions of NPFA 70, Article 300, without pigtails.
- J. Device Installation:
  - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
  - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
  - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductors tightly clockwise, 2/3 to 3/4 of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

### **3.02 FIELD QUALITY CONTROL**

- A. Inspect each wiring device for defects.
- B. Operate each wall switch and sensor with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.
- F. The Engineer and Owner's personnel reserve the right to be present at all tests.

### **3.03 OCCUPANCY SENSORS**

- A. Power packs used in return air plenum ceiling areas shall be installed in an approved enclosure or UL listed for return air plenum.
- B. Provide a minimum of 4' of coiled cable for ceiling-mounted sensors.
- C. Sensitivity Test: After the sensor has been energized for at least 15 minutes, walk to the middle of the room (if conference room) or sit at the normal desk position (if and office). Make no motion for 20 seconds. Move one arm up and down slowly. The test LED should blink.
- D. Time Delay Test: Set the time delay for 10 minutes. Walk into the room to activate the sensor then leave room. Sensor must turn lights off at approximately 10 minutes. Walk into the room again to reactivate the lights. Lights should activate within 1 second.
- E. For lights on emergency power without a remote transfer device, route the emergency circuit through a separate relay controlled by the occupancy sensor(s) in the respective area. For lights on emergency power with a remote transfer device, the emergency power does not get routed through the occupancy sensor relay, but the normal power does get routed through the occupancy sensor relay.

### **3.04 ADJUSTING**

- A. Adjust devices and wall plates to be flush and level.
- B. Mark all conductors with the panel and circuit number serving the device with a machine generated label, at the device, and on the back of the device cover.

### **3.05 TESTING**

- A. Perform tests and inspections and prepare test reports.
  1. Test Instruments: Use instruments that comply with UL 1436.
  2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
  1. Line Voltage: Acceptable range is 105 to 132 V.
  2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
  3. Ground Impedance: Values of up to 2 ohms are acceptable.
  4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  5. Using the test plug, verify that the device and its outlet box are securely mounted.
  6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight blade [convenience outlets in patient-care areas] [hospital-grade convenience outlets] for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

END OF SECTION

**SECTION 26 27 28**  
**DISCONNECT SWITCHES**

**PART 1 - GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes disconnect switches and enclosures.

**1.02 SECTION INCLUDES**

- A. Disconnect Switches

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.
- B. Section 26 28 13 – Fuses

**1.04 SUBMITTALS**

- A. Include outline drawings with dimensions, and equipment ratings for voltage, ampacity, horsepower, and short circuit.

**1.05 OPERATION AND MAINTENANCE DATA**

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

**1.06 PROJECT COORDINATION**

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Disconnect switch manufacturer shall be the same manufacturer as switchboards, distribution panelboards, branch circuit panelboards and motor starters.

**PART 2 – PRODUCTS**

**2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Products.
  - 2. General Electric Company
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; Schneider Electric

**2.02 DISCONNECT SWITCHES**

- A. Fusible Switch Assemblies (use only when overcurrent protection is required):UL 09 and NEMA KSI, horsepower rated Type HD, Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: designed to accommodate Class R cartridge type fuses.
- B. Nonfusible Switch Assemblies: UL 89 and NEMA KSI, horsepower rated Type HD Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Enclosure: NEMA Type 1 and 3R as indicated on Drawings.
- D. Provide manufacturer's equipment ground kit in all disconnect switches.
- E. Provide one NO/NC (form C) auxiliary contacts arranged to activate before switchblades open. Provide internally mounted neutral bar where used with 4 wire circuits.
- F. Provide UL Listed service rating where required.

**PART 3 – EXECUTION**

**3.01 INSTALLATION**

- A. Install disconnect switches where indicated on Drawings.
- B. Provide identification as specified in Section 26 05 53.

END OF SECTION

**SECTION 26 28 13  
FUSES**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes 250 and 600 volt fuses.

**1.02 SECTION INCLUDES**

- A. 250 Volt Fuses
- B. 600 Volt Fuses
- C. Spare-Fuse Cabinet

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 24 13 – Switchboards
- C. Section 26 24 16 – Panelboards
- D. Section 26 27 28 – Disconnect Switches
- E. Section 26 28 16 – Enclosed Switches and Circuit Breakers
- F. Section 26 29 00 – Low Voltage Controllers

**1.04 SUBMITTALS**

- A. Provide device dimensions, nameplate nomenclature, and electrical ratings.
- B. Submit manufacturer's product data sheets with installation instructions.

**1.05 REGULATORY REQUIREMENTS**

- A. Listed by Underwriter's Laboratories, Inc., and suitable for specific application.

**1.06 COORDINATION**

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit levels.

**1.07 EXTRA MATERIALS**

- A. Provide three (3) spares of each size and type fuse.

**PART 2 – PRODUCTS**

**2.01 250 VOLT FUSES**

- A. Fuses 600 Amperes and Less: Dual element, time delay, 250 volt, UL Class RK 5 Interrupting Rating: 200,000 rms amperes.

**2.02 600 VOLT FUSES**

- A. Fuses 600 Amperes and Less: Dual element, time delay, 600 volt, UL Class RK 5 Interrupting Rating: 200,000 rms amperes.
- B. Fuses 601 Amperes and Larger: Time delay, 600 volt, UL Class L. Interrupting Rating: 200,000 rms amperes.
- C. Provide enclosure for spare fuses.

**PART 3 – EXECUTION**

**3.01 INSTALLATION**

- A. Fuses shall not be installed until equipment is ready to be energized.

B. Install spare fuse storage enclosure in Electrical Room.

END OF SECTION



**SECTION 26 29 00**  
**LOW-VOLTAGE CONTROLLERS**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. Base Bid: The work under this section includes manual motor starters, magnetic motor starters, combination magnetic motor starters and motor control centers.

**1.02 SECTION INCLUDES**

- A. Manual Motor Starters
- B. Magnetic Motor Starters

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 01 91 13 – Commissioning Requirements
- C. Section 26 05 29 – Hangers and Supports for Electrical Systems
- D. Section 26 27 28 – Disconnect Switches

**1.04 SUBMITTALS**

- A. Indicate on shop drawings, front and side views of motor control center enclosures with overall dimensions. Include conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.
- B. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.

**1.05 REFERENCE STANDARDS**

- A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- B. ANSI/UL 198E - Class R Fuses.
- C. NEMA AB 1 - Molded Case Circuit Breakers.
- D. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- E. NEMA KS 1 - Enclosed Switches.
- F. NEMA PB 1 - Panelboards.
- G. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

**1.06 OPERATION AND MAINTENANCE DATA**

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

**1.07 DELIVERY, STORAGE AND HANDLING**

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

**1.08 COORDINATION WITH OTHER TRADES**

- A. Motors: In general, all electric motors required for this installation will be supplied with equipment, apparatus and/or appliances covered under other sections of the specifications.
- B. For the sake of consistency and conformity of manufacturer, design and construction, all motors shall conform to the following description unless otherwise noted or required.
  - 1. Motors 1/3 HP and smaller shall be wound for operation on single phase, 60 Hz. service unless otherwise noted.

2. Motors 1/2 HP and above shall be wound for operation on 3 phase, 60 Hz service unless otherwise noted.
  3. Refer to drawings in each case in order to verify voltage characteristics required.
- C. Equipment:
1. All building utility motors such as fans, pumps, overhead doors, etc., together with certain "controlling equipment" for same, except motor starters and related apparatus, will be furnished under other sections of the specifications and delivered to the building site unless specifically noted otherwise. The above mentioned "controlling equipment" pertains to electrical thermostats, electro-pneumatic and pneumatic-electric and detection devices, or any other device not purely electrically operating in nature.
  2. The Electrical Trade shall set and connect all specified starting equipment, install all power conduits and wiring and shall furnish and make all connections from starting equipment to motors as required to leave the apparatus in running condition.
- D. Wiring Connections:
1. Furnish branch circuits for all motors to the starting equipment and then to the motors, complete with all control wiring for automatic and remote control where required or noted. Conduits to motors shall terminate in the conduit fittings on the motors, the final connection being made with flexible, PVC-coated metal conduit.
  2. Provide all necessary labor and material to completely connect all electrical motors and controls (where required) in connection with the building utility equipment, including fans, etc.
- E. Power Branch Circuits:
1. Wire sizes for branch circuits not specifically called for on drawings or in specifications shall be based on 125 percent of the full load current of the motor unless the voltage drop of motor branch circuits exceeds 1-1/2 percent from the distribution panel to the motor; in which case, voltage drop shall govern wire sizes. A power factor of 80 percent shall be used for motors in such calculations.

## 1.09 PROJECT COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Motor starter manufacturer shall be the same manufacturer as distribution panelboards, branch circuit panelboards, and disconnect switches.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Products.
  2. General Electric Company
  3. Siemens Energy & Automation, Inc.
  4. Square D; Schneider Electric

### 2.02 MANUAL MOTOR STARTERS

- A. Manual Motor Starter: NEMA ICS 2; size as shown on Drawings. AC general-purpose Class A manually operated full-voltage controller for induction motors rated in horsepower, with overload protection, red pilot light and toggle operator.
- B. Manual Motor Starter: The single phase motor starter shall consist of a manually operated quick-make toggle mechanism lockable in the "off" position which shall also function as the motor disconnect. The starter shall provide thermal overload protection, run status pilot light and fault pilot light. The starter must include the capability to operate in both manual and automatic control modes. In automatic mode, the starter shall have the capability to integrate with a building automation system by providing terminals for run input, run status output and fault output. All control terminals shall be integrated in the starter. At a minimum, each single phase starter shall include an interposing run relay and current sensing status output relay. Single phase motor starter shall be in a surface mount enclosure. Approved manufacturer: Cerus Industrial, model BAS-IP or approved equal.

- C. Enclosure: NEMA Type: 1.
- D. Provide manufacturer's equipment ground kit in all starter enclosures.

### **2.03 MAGNETIC MOTOR STARTERS**

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower; NEMA size 0 minimum.
- B. Full Voltage Starting: Non-reversing type.
- C. Reduced Voltage Starting: Solid-state type, trip current rating shall be adjustable. The overload shall be self-powered, provide phase loss and phase unbalance protection, have a permanent tamper guard and be ambient insensitive. The overload shall have a mechanical test function.
- D. Two Speed Starting: Two speed, [one] [two] winding, [constant torque] [variable torque] [constant horsepower] type. Provide integral time delay transition between FAST and SLOW speeds.
- E. Size: NEMA ICS 2; size as shown on Drawings, size 0 minimum.
- F. Coil Operating Voltage: 120 volts, 60 Hz.
- G. Overload Protection: Solid state adjustable.
- H. Enclosure: NEMA Type: As indicated on the drawings. Provide manufacturer's equipment ground kit in all starter enclosures.
- I. Auxiliary Contacts: NEMA ICS 2; two field convertible contacts in addition to seal-in contact.
- J. Indicating Lights: NEMA ICS 2; LED Push-to-test type. RUN: red in front cover.
- K. Provide phase loss protection relay with each motor starter, with contacts to de-energize each motor starter.
- L. Control Power Transformers: Each magnetic starter shall have a fused primary and a fused 120Vsecondary control transformer, sized for the load, 100 VA minimum. Additionally, the X2 terminal of the control transformer shall be grounded.
- M. Combination Motor Starters: Combine motor starters with non-fused disconnect in common enclosure.

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Install motor control equipment in accordance with manufacturer's instructions.
- C. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.
- D. Adjust solid state overload device to match motor characteristics.

### **3.02 IDENTIFICATION**

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device.

END OF SECTION

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**SECTION 26 51 13**  
**INTERIOR LIGHTING FIXTURES, LAMPS, AND BALLASTS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. The work under this section includes interior luminaires and accessories, exit signs, lamps, and ballasts. Included are the following topics:

**1.02 RELATED WORK**

- A. Applicable provisions of Division 1 govern work under this Section.  
B. Section 26 27 26 - Wiring Devices

**1.03 REFERENCE STANDARDS**

- A. RoHS - Restriction of Hazardous Substances. Council of the European Union (EC) Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment.  
B. LM-79-08 (or latest) - IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.  
C. LM-80-08 (or latest) - IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.  
D. TM-21-11 (or latest) - IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.  
E. NEMA SSL 1-2010 (or latest) - Electronic Drivers for LED Devices, Arrays, or Systems.

**1.04 DEFINITIONS**

- A. Driver - the power supply used to power LED luminaires, modules, or arrays.  
B. L70, L70, or L70% - The reported life of an LED component or system to reach 70% lumen maintenance, or 70% of the LED's original light output. This test is being developed by the IES and is currently described by TM-21-11.  
C. LED's - Broadly defined as complete luminaire with light emitting diode (LED) packages, modules, light bars or arrays, complete with driver.  
D. LED luminaire failure - Negligible light output from more than 10 percent of the LED's constitutes luminaire failure.

**1.05 SUBMITTALS**

- A. Include outline drawings, lamp and ballast data, support points, weights, accessory information and performance data for each luminaire type.  
B. Luminaires with unique mounting elements such as illuminated corners or non-typical mounting installations such as recessed in a vertical wall, shall have a project specific factory shop drawing submitted.  
C. For each luminaire type, submit luminaire information including catalog cuts with highlighted catalog numbers and required accessories:
- Luminaire:
    - Manufacturer and catalog number.
    - Type (identification) as indicated on the plans and schedule.
  - Ballast:
    - Manufacturer and catalog number.
    - Type (Programmed Start, etc.), Ballast Factor, THD, etc.
    - Quantity per luminaire.

**1.06 OPERATION AND MAINTENANCE DATA**

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

**1.07 EXTRA MATERIAL**

- A. Provide three (3) percent of each lamp type, but not less than one (1) of each type.

- B. Provide one (1) of each type of LED module, light bar, or array (if applicable). If the LED's are integrated into the luminaire and are not separate components, then extra LED's are not required.
- C. Provide one (1) ballast of each type. This includes LED drivers.

## **PART 2 - PRODUCTS**

### **2.01 INTERIOR LUMINAIRES AND ACCESSORIES**

- A. See the Luminaire Schedule on the drawings for type of luminaires and catalog numbers. Catalog numbers are shown on the drawings for quality and performance requirements only. Luminaires manufactured by others are equally acceptable provided they meet or exceed the performance of the indicated luminaires, and meet the intent of the design.
- B. Luminaire shall be certified by a Nationally Recognized Testing Laboratory (UL, ETL, or IEC).
- C. Provide all luminaires with quick-connect disconnecting means, similar to Thomas & Betts Sta-Kon.

### **2.02 LED LUMINAIRES**

- A. LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
  - 1. Minimum Light Output.
  - 2. Zonal Lumen Requirements.
  - 3. Minimum Luminaire Efficacy.
  - 4. Minimum CRI.
  - 5. L70 Lumen Maintenance.
  - 6. Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
- B. Color Temperature of 3000K-4100K for interior luminaires as listed in the Luminaire Schedule on the plans.
- C. Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires.
- D. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- E. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- F. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
- G. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
- H. Driver shall have a rated life of 50,000 hours, minimum.
- I. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- J. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
- K. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.
- L. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C).
- M. LED driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
- N. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- O. Luminaire shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
- P. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
- Q. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
- R. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
- S. All luminaires shall be provided with knockouts for conduit connections.

- T. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).
- U. Provide all of the following data on submittals:
  - 1. Delivered lumens
  - 2. Input watts
  - 3. Efficacy
  - 4. Color rendering index.
- V. LED Luminaires used for Emergency Egress Lighting:
  - 1. The failure of one LED shall not affect the operation of the remaining LEDs.

### **2.03 EXIT SIGNS**

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  - 1. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. 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.
    - d. Test Push Button: Push-to—test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    - f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

### **2.04 EMERGENCY LIGHTING UNITS**

- A. Description: Self-contained units complying with UL 924.
  - 1. Battery: Sealed, maintenance-free, lead-acid type.
  - 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 form 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. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  - 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - 6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Verify ceiling types with Architectural plans or with existing ceilings. Verify specified luminaires are compatible with specified ceiling type(s) prior to ordering luminaires.
- B. Install in accordance with manufacturer’s instructions.
- C. Install suspended luminaires using aircraft cable, or pendants supported from swivel hangers. Heavy duty chain supports may be used where indicated on the luminaire schedule. Provide aircraft cable, pendants, or chain lengths required to suspend luminaire at indicated height. All aircraft cables or pendant supported luminaires shall have an independent support to structure at all cable or pendant support locations. When chain is used, tie-wrap the luminaire whip to the chain.

- D. Provide independent support for all luminaires over 50 lbs.
- E. Locate ceiling luminaires as indicated on reflected ceiling plan.
- F. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- G. The Contractor shall install luminaire supports as required. Luminaire installations with luminaires supported only by insecure boxes will be rejected. It shall be the Contractor's responsibility to support all luminaires adequately, providing extra steel work for the support of luminaires if required. Any components necessary for mounting luminaires shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.
- H. Install recessed luminaires to permit removal from below.
- I. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- J. Install code required hardware to secure recessed grid-supported luminaires in place.
- K. Install wall mounted luminaires and exit signs at height as scheduled. Use pendants supported from swivel hangers in exposed ceiling/structure locations where necessary to mount exit signs at the specified height.
- L. Install accessories furnished with each luminaire.
- M. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- N. Bond luminaires and metal accessories to branch circuit equipment grounding conductor.

### **3.02 ADJUSTING AND CLEANING**

- A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Aim and adjust luminaires as indicated on Drawings or as directed by the A/E.
- C. Touch up luminaire finish at completion of work.

### **3.03 INTERFACE WITH OTHER PRODUCTS**

- A. Provide controls as indicated on the plans. Refer to section 26 27 26 and 26 09 43. All controls shall be compatible with the luminaires/ballasts/drivers being installed.

### **3.04 FIELD QUALITY CONTROL**

- A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

### **3.05 LUMINAIRE CONNECTIONS INCLUDING MASTER-SATELLITE**

- A. Provide direct box or conduit connections for surface mounted and recessed luminaires. Use a luminaire fixture whip from a J-box for recessed lay-in luminaires. Luminaire fixture whips shall be aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC). Cable/Conduit whips shall be 3/8" (10 mm) minimum diameter and six foot (1.8 m) maximum length. Flexible whips between master and satellite luminaires may be supported off of the ceiling grid wires. Cable/conduit whip length shall allow movement of the luminaire for maintenance purposes. Flexible metal conduit shall not be used for connections to luminaires where the conduit is exposed in finished spaces.
- B. The flexible connectors shall be steel, galvanized, clamp type with locknut, snap-in type with locknut, or snap-in connector type, including those used on the master-satellite unit.

### **3.06 TRAINING**

- A. See Section 26 05 00 for general training requirements.

### **3.07 CONSTRUCTION VERIFICATION CHECKLIST**

- A. Contractor is responsible for utilizing the construction verification checklists supplied under these specifications in accordance with the procedures defined for construction verification checklists.

END OF SECTION



**SECTION 28 31 00**  
**FIRE DETECTION AND ALARM**

**PART 1 – GENERAL**

**1.01 SCOPE OF WORK**

- A. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations associated with the installation of the new Fire Alarm System as shown on the drawings and as herein specified.

**1.02 SECTION INCLUDES**

- A. Multiplex/Intelligent Fire Alarm Control Panel (FACP)
- B. Operation: Multiplex/Intelligent Fire Alarm System
- C. Central Monitoring
- D. Operation: One-Way Voice Communications
- E. NAC Booster Panels (Remote Power Supplies)
- F. Multiplex/Intelligent Peripheral Devices
- G. Fault Isolator Module (FIM)
- H. Conventional Peripheral Devices
- I. Audio/Visual Notification Appliances
- J. Printers and Terminals
- K. Special Devices

**1.03 RELATED WORK**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.
- B. Section 26 05 00 – Common Work Results for Electrical
- C. Section 26 05 26 – Grounding and Bonding for Electrical Systems
- D. Section 26 05 29 – Hangers and Supports for Electrical Systems
- E. Section 26 05 33 – Raceway and Boxes for Electrical Systems
- F. Section 26 05 53 – Identifications for Electrical Systems
- G. Section 26 27 26 – Wiring Devices

**1.04 SUBMITTALS**

- A. Under the provisions of Section 26 05 00 and Division 1, submit the following for approval prior to ordering any equipment in accordance with requirements of Division 1, General Conditions. Submit a total of ten (10) sets.
- B. Copies of CAD Files (AutoCAD, latest version, or DXF Format) for the Fire Alarm floor plans will be made available to the successful bidder for preparation of the required shop drawings and as-builts.
- C. **REQUIRED SUBMITTAL MATERIALS:**
  - 1. The following items, and any additional items required per Section 26 05 00, shall be included within the submittal package:
    - a. Although they may be submitted under separate cover, Submittal Brochures/Booklets/Binders and Shop Drawings shall be submitted together, and shall be treated as a complete set.
  - 2. **COVER SHEET:**
    - a. The submittals shall contain a cover sheet, which shall include the following information:
      - 1) Submittal Date
      - 2) Specification Section(s)
      - 3) Fire Alarm Contractor (Contact Name, name, address, and telephone number)
      - 4) Electrical Contractor (Contact Name, name, address, and telephone number)
      - 5) Project Name, Project City, Project State, and Project Address.
  - 3. **TABS AND TABLE OF CONTENTS:**
    - a. The Table of Contents shall appear immediately behind the Cover Sheet, and shall contain a complete listing of all of the tabs contained within the binder/booklet.

- 1) Tabbed index sheets shall be inserted into each of the binders, such that each binder is clearly sub-divided into sections. Tabbed sections shall be provided, at minimum, for the following:
- 2) One section for each building – ALL submittal data, which applies to any particular building, shall be located within the tabbed section for the corresponding building. All submittal data within each “building” section shall appear in the same order.
- 3) One section for manufacturer’s data sheets – divided into sub-sections for the following:
  - a) Panel Equipment (Panels, Panel Components/Modules, Printers, Annunciators, etc.)
  - b) Addressable Field Devices (Initiating and Control/Monitoring/Isolation)
  - c) Non-Addressable Field Devices (Initiating Devices, relays, etc.)
  - d) Notification Appliances
  - e) Fire-Fighter Communications Equipment if applicable
4. EQUIPMENT LIST:
  - a. A complete equipment list of all components, including the following: Quantity, Manufacturer, Part Number, and Description. If the supplier uses different part numbers from those of the actual manufacturer, the actual manufacturer and part numbers as they appear – marked on the shipping box/packages, shall also be identified on this list.
    - 1) Each Equipment List shall include a complete listing of the modules, components, and software included for each modular Fire Alarm Control Panel, Network Panel, Transponder, Outboard Gear Panel or Annunciator. Such items shall be listed in a manner that clearly indicates that such items are parts of/components of a larger unit. Simply stating a single part number and description for such panels shall be unacceptable.
    - 2) A separate list shall be included for each section, with items grouped by system.
    - 3) For projects involving multiple systems, separate equipment lists shall be provided - one for each system.
    - 4) Spare Parts shall also be listed separately, and shall be identified clearly as “Spare Equipment”.
5. PRODUCT DATA:
  - a. Manufacturer's product data sheets and equipment description of all system components. These data sheets shall be highlighted or suitably marked, so that included items and options are indicated. On data sheets that include multiple products, products that are not used shall be crossed out.
    - 1) Product Data Sheets shall be organized, in order, corresponding to the FIRST occurrence of the corresponding item on the equipment list
6. SEQUENCE OF OPERATION:
  - a. Complete sequence of operations of all functions of the system. This sequence of operation shall be custom-created for this particular job.
    - 1) In order to satisfy this submittal requirement, it shall be acceptable to include copies of the “Operation” portions of the specifications, including any applicable schedules/other supplementary information. Copied specification pages shall be marked and highlighted, where the programmed operation will differ from the specified operation. Copied specification pages shall be marked “no changes”, where no significant deviation will occur. Other acceptable alternatives shall include written narratives, organized in a logical manner, and Matrix Charts.
    - 2) Where Matrix Charts are provided, such charts shall be organized and labeled clearly, and shall incorporate suitable levels of detail (refer to NFPA-72 (1999) A-7-5-2.2(9) for an example of an acceptable matrix chart). The Leftmost column of the Matrix Chart shall include groupings of initiating devices and other function switches. The Topmost Row shall include groupings of notification appliances and output devices.
7. BATTERY CALCULATIONS:
  - a. These calculations shall clearly illustrate both the Standby and Alarm loads, due to the various field devices and panel components/modules. It is generally recommended to submit such calculations in a “spreadsheet” format. These calculations shall include any reserve/additional capacity, as required elsewhere within these specifications. Final results shall indicate both the minimum battery capacity required and the capacity actually provided.
8. AMPLIFIER CAPACITY CALCULATIONS:
  - a. For all speakers plus all required spare capacity.

9. ADDRESSABLE DEVICE/DESCRIPTOR LIST:
- a. Prior to programming the system, submit a chart or printout, listing every system address provided for purposes of alarm initiation, status monitoring, supervised signaling, and auxiliary controls. This printout shall include the corresponding device type and field programmable “custom labels”, as they will be displayed on the New System – at the FACP and Local Annunciator. The addresses listed within this document shall directly correspond to the addresses marked on the submitted floor plan drawings. This list will be modified as needed by the Owner and returned to the contractor for final programming in to the system.
10. NAC WIRE DROP CALCULATIONS:
- a. Calculations shall be provided for all Notification Appliance Circuits (NAC) in the building. It is recommended that this calculation should follow a “spreadsheet” format, and should clearly indicate the following:
    - 1) The name of the circuit
    - 2) Point of origin of the circuit
    - 3) Complete list of all devices served by the circuit, including location and type of each device
    - 4) Alarm Current Draw for each device, at the applied voltage
    - 5) Applied Voltage (Based on anticipated battery voltage after specified stand-by & alarm operation)
    - 6) Acceptable Operating Voltage for each type of device on circuit
    - 7) Calculated Voltage at each device on circuit
  - b. These calculations should mathematically prove that all Notification Appliances on the circuit will receive acceptable power for proper operation, under “worst-case-scenario” conditions.
11. SHOP DRAWINGS:
- a. All submitted drawings shall be created using CAD, and shall be coordinated so that terminal numbering, circuit designation and equipment or device designations are the same on all drawings. All drawings must be submitted and approved by the engineer before ordering or fabrication starts, but such approval will not waive any specification requirements unless specifically stated. CAD formatted fire alarm drawings may be made available from the A/E at a cost of \$100 per sheet requested.
  - b. Each and every sheet of the Shop Drawings shall be clearly and prominently identified as “SHOP DRAWINGS – PREPARED BY: (insert name of contractor firm preparing the shop drawings)”, and shall be clearly and visibly different from the Contract Documents/Bidding Drawings. As a minimum, the name and company logo for the Electrical Contractor and the Fire Alarm Equipment Vendor should be added to each sheet, and a revision date shall be inserted on each sheet.
  - c. The submitted Shop Drawings shall include the following types of drawings:
    - 1) PROJECT-SPECIFIC DRAWINGS:
      - a) Project-Specific Drawings. These drawings shall include the following:
      - b) SYSTEM RISER DRAWING:
      - c) A separate riser drawing shall be furnished for each system. Each System Riser shall illustrate all fire alarm circuits, which serve the facility, and shall incorporate the following information, in a clear, concise format:
        - Point of origin of each circuit (usually a Panel, or a Module within a panel)
        - Circuit type and labeling
        - Area served by each circuit
        - Wire/cable type and size
        - Locations of Panelboards where primary system power is obtained
        - The following information for each Field Device:
          - Device Type
          - Circuit(s) to which device is connected
          - Locations of any End-Of-Line Resistor (EOLR)
          - (and the circuit terminated by any such EOLR)

12. BLOCK DIAGRAMS:

- a. Showing layout and operation of the entire system.
- b. FLOOR PLANS:

- 1) These drawings shall consist of edited versions of the Contract Documents, which shall include the following information:
  - a) Fire Department Response Location(s)
  - b) Annunciator Location(s)
  - c) Panel Location(s)
  - d) Device Addresses - The addresses shown on these drawings shall directly correspond to the chart or printout, as specified previously, which spells out specific information about each device, including the field programmable "custom label".
- D. **TYPICAL DEVICE/MODULE WIRING DETAILS:**
  1. Component and module wiring diagrams – intended to illustrate terminations and wiring connections to each typical Field Device (Detectors, Notification Appliances, etc.), and each typical panel component/module utilized within the system. This set of drawings shall only include diagrams for modules and components, which are actually used in the provided system(s).
  2. These drawings shall incorporate clear labeling/nomenclature, which shall clearly indicate the corresponding field device or module, to which it corresponds.
  3. **OMISSION OF ANY OF THE ABOVE MATERIALS FROM THE SUBMITTALS SHALL RESULT IN AN IMMEDIATE REJECTION OF THE SUBMITTALS FOR THIS PROJECT.** If the EC/FAC has any questions concerning the preparation of these materials, please contact the Engineer.

#### **1.05 QUALITY ASSURANCE**

- A. Unless specifically stated otherwise, each and all items of the fire alarm system shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the UL label.
- B. Notification Appliances may be products of a single, different manufacturer – provided that the Primary Equipment Provider or Manufacturer provides written documentation of compatibility, and agrees to assume any and all responsibility for compatibility with the Control Equipment.
- C. In addition to previously listed UL standards, all control equipment shall be listed under the following UL Standards:
  1. UOJZ UL category UOJZ as a single control unit. Partial listing shall NOT be acceptable.
  2. UL 864 Transient protection
  3. UL 497B Isolated Loop Circuit Protectors. Where fire alarm circuits leave the building, additional transient protection must be provided for each circuit.
  4. UL 1481 Power Limited Applications.

#### **1.06 OPERATION AND MAINTENANCE DATA**

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
- B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:
  1. A material guide, which shall contain the replacement part numbers and description of all components used. If this information is included in an instruction section for any of the equipment, it will not be necessary to duplicate the list. In either case, the parts list shall be associated with its respective chassis, modules or kit wherein it is found. A total listing of parts without such grouping will not be acceptable.
  2. Catalog data or literature
  3. Manufacturer's operating instructions.
  4. Manufacturer's maintenance instructions
  5. Installation instructions
  6. Name, address and telephone number of source for parts (i.e. keys, guards, etc.) not supplied by the Fire Alarm Manufacturer
  7. Copies of all approved shop drawings
  8. An updated copy of the submitted sequence of operation, revised to reflect any implemented changes

#### **1.07 DELIVERY, STORAGE AND HANDLING**

- A. Receive equipment at job site; verify applicable components and quantity delivered.

- B. Handle equipment to prevent internal components' damage and breakage, as well as denting and scoring of enclosure finish.
- C. Do not install damaged equipment.
- D. Store equipment in a clean, dry space and protect from dirt, fumes, water, and construction debris and physical damage. Make arrangements with the Owner at the pre-construction meeting for storage of equipment on the premises.

**1.08 DESCRIPTION OF WORK**

- A. The complete installation shall be done in a neat, workmanlike manner in accordance with the applicable requirements of NFPA 70 - Article 760 and the manufacturer's recommendations.
- B. The New Fire Alarm System shall consist of a single Main Fire Alarm Control Panel (FACP) and Fire Alarm Annunciator Panel (FAAP), unless a different design is submitted and approved.
- C. The New Fire Alarm System shall be configured as a local protective signaling system, as defined in NFPA-72, and shall use/incorporate the following features, as a minimum:
  - 1. The latest intelligent digital, addressable technology (detectors/sensors and modular panel equipment) currently available from the manufacturer
  - 2. A Single-Channel, selective [non-selective], One-Way Voice Communications (EVAC) System - This EVAC System shall be designed to Automatically Generate particular tones, and shall allow properly trained personnel to make manual announcements to [the entire building] [the selected areas].
  - 3. Non-Coded, Speaker-type Audible Notification Appliances
- D. The system shall be an intelligent/digital type, and shall consist of the following panels:

PANEL NAME:	PANEL TYPE:	PANEL LOCATION:
FACP	Main Fire Alarm Control Unit	See Floor Plan
FAAP	Fire Alarm Annunciator Panel	See Floor Plan

**1.09 REGULATORY REQUIREMENTS**

- A. The complete installation shall conform to the applicable sections of the latest edition of the following Codes and Standards:
  - 1. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):
    - a. NFPA-70 National Electrical Code (NEC) Generally, and Article 760 in particular
    - b. NFPA-72 National Fire Alarm Code
    - c. NFPA 101 Life Safety Code
    - d. IBC International Building Code
    - e. IFC International Fire Code
    - f. IMC International Mechanical Code
  - 2. NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)
  - 3. UNDERWRITERS' LABORATORIES, INC. (UL)
    - a. UL-864 Control Units for Fire Protective Signaling Systems
    - b. UL-268 Smoke Detector for Fire Protective Signaling Systems
    - c. UL-217 Smoke Detectors for Single and Multiple Station
    - d. UL-521 Heat Detectors for Fire Protective Signaling Systems
    - e. UL-464 Audible Signaling Appliances
    - f. UL-1971 Visual Signaling Appliances
    - g. UL-38 Manually Actuated Signaling Boxes
    - h. UL-1481 Power Supplies for Fire Protective Signaling Systems

**1.10 MANUFACTURER PROVIDED SERVICES**

- A. A manufacturer-trained service technician shall provide the following installation supervision. This Technician shall be certified by the equipment manufacturer, and shall have had a minimum of two (2) years of service experience in the fire alarm industry.
- B. The technician's name shall appear on equipment submittals and a letter of certification from the fire alarm manufacturer shall be sent to the project engineer. The manufacturer's service technician shall be responsible for the following items:

1. Pre-installation visit to the job site to review equipment submittals and verify method by which the system should be wired.
2. Periodic job site visits to verify installation and wiring of system, and to perform any partial system programming – required to permit portions of the existing system to be removed.
3. Upon completion of wiring, final connections shall be made under the supervision of this technician, and final checkout and certification of the system.
4. At the time of final checkout, technician shall give operational instructions to the Owner and/or his representative on the system.
5. All job site visits shall be dated and documented in writing and signed by the Electrical Contractor. Any discrepancy shall be noted on this document and a copy kept in the system job folder that shall be available to the Project Engineer any time during the project.

#### **1.11 QUALIFICATIONS**

- A. All equipment shall be supplied by a firm, which specializes in fire alarm and smoke detection systems with a minimum of five (5) years-documented experience. The company shall be an authorized distributor of the proposed equipment
- B. All work shall be performed by a licensed contractor, who is regularly engaged in the installation and servicing of fire alarm systems. Proof of five (5) years documented experience and of factory authorization to furnish and install the equipment proposed shall be furnished prior to contract award, if required by Division of State Facilities.
- C. Contractor shall be located within three (3) hours of travel time or less from the site of this project.

#### **1.12 PLAN REVIEW**

1. CITY OF MADISON – FIRE DEPARTMENT INSPECTION / FIRE ALARM WORK PERMIT
2. PER A LOCAL ORDINANCE (City of Madison General Ordinance 34 – Fire Prevention Code) EFFECTIVE AS OF JULY 2, 2002 - THE FIRE ALARM AND FIRE PROTECTION SYSTEMS, AS INSTALLED WITHIN THIS FACILITY ARE SUBJECT TO PERMIT REQUIREMENTS AND INSPECTIONS OF THE INSTALLATION BY THE CITY OF MADISON – FIRE DEPARTMENT / FIRE PREVENTION BUREAU.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SCHEDULING, COORDINATING, AND ATTENDING THIS INSPECTION, AND FOR PAYMENT OF ALL ASSOCIATED INSPECTION / PERMIT FEES.
4. This process normally involves both a plan review and inspections; however, for State-Owned Buildings, the City of Madison only performs the inspections, with the Plan Review being performed by DSPS as specified previously under “Submittals”.
5. Copies of the applicable Code can be obtained on-line, via the following link:
6. <http://www.cityofmadison.com/sites/default/files/city-of-madison/fire/documents/MGOchapter34.pdf>
7. Because of this Permit / Inspection process, the following procedure shall be followed by the Electrical Contractor, (and by their sub-contractors, where particular arrangements have been made between the EC and their sub-contractor(s)):
8. First, the Electrical Contractor shall obtain State-Approval of the Installation Drawings, per the process previously described under “Submittals – Plan Review Process”, as found within this specification.
9. Once the State-Approved Drawings are received by the contractor, and PRIOR TO STARTING ANY CONSTRUCTION, the Electrical Contractor shall completely fill-out submit the proper “City of Madison Fire Department – Fire Protection System Work Permit Application” form. If required, suitable fee payment shall accompany the form. Copies of this form may be obtained via the following link:<http://www.cityofmadison.com/sites/default/files/city-of-madison/fire/documents/workpermitapp.pdf>
10. Once the form has been received, processed, and accepted by the Madison Fire Department (MFD), MFD will issue the proper permit, and construction may begin.
11. The inspection program involves at least two inspections, as follows:
12. A Rough-In Inspection shall be scheduled and performed, prior to installation of any new devices. In certain buildings (high-rises), multiple rough-in inspections may be required, as subsequent areas are completed. It is highly recommended that these inspections should be carefully scheduled and adhered to, since potentially costly mistakes can be prevented before the associated devices are completely installed.

13. Final Inspection of the System – prior to this inspection, the Electrical Contractor shall have conducted all necessary pre-testing.
14. Questions regarding this inspection program may be directed to:
  - City of Madison Fire Department
  - 314 W Dayton St
  - Madison, WI 53703
  - Phone: (608) 266-4420
  - Fax: (608) 267-1153
  - fire@cityofmadison.com

### **1.13 PLAN REVIEW FEES**

- A. Fees shall be determined in accordance with Table 302.31-1 or Table 302.31-2 found in Chapter SPS 302 of the Wisconsin Administrative Code.
- B. Reduced plan review fees (Table 302.31-2) may be utilized for projects in municipalities that perform inspections as an agent of the Division of Safety & Buildings.
- C. A list of “Delegated Municipalities” that perform inspections can be found at:
- D. <http://dsps.wi.gov/sb/SB-CommBldgsDeleMunis.html>
- E. Reduced fees (Table 302.31-2) do not apply to State-owned buildings.
- F. In addition to the plan review fee, a plan entry fee of \$100 shall be included with each submittal.
- G. Per SPS 302.10, plan review fees shall be doubled for projects where the installation, erection or construction was initiated without the required Departmental approval.

### **1.14 WHAT TO SUBMIT**

- A. Four (4) sets of properly signed/sealed fire alarm plans.
  1. In an effort to limit handling and mailing costs, the submitter may opt to submit one (1) complete set of plans and three (3) index sheets. The plan set will be retained. A copy of the approval letter will be attached to the index sheets and returned. It shall then be the responsibility of the submitter to properly attach the approval and index page to plans matching the copy on file with the Department.
  2. A maximum of five (5) plan sets may be submitted. Additional plan sets (in excess of 5) will incur a \$25/set fee.
- B. One (1) set of battery calculations.
- C. One (1) set of voltage-drop calculations for each notification circuit.
- D. One (1) copy of applicable material data sheets.
- E. A detailed, project-specific ‘Sequence of Operation’ which clearly identifies all functions of the fire alarm system, including the transmission of alarm, supervisory and trouble signals to an approved supervising station.
- F. A completed SBD-118 application form.
  1. The application must identify the Transaction ID No. related to the parent building review approval. Fire alarm submittals for new construction, building additions or building alterations cannot be reviewed prior to building plan approval.
  2. The original supervising professional’s signature for the building project is applicable to fire alarm submittals and a separate signature is not required. Standalone fire alarm system submittals do not require a supervising professional.
- G. Plan review fee.

### **1.15 FORMS**

- A. SBD-118 (R11/11) can be downloaded from: <http://dsps.wi.gov/sb/docs/sb-Form118App.pdf> (PDF) or <http://dsps.wi.gov/sb/docs/SB-Form118App.doc> (Word)
- B. Visit Department of Safety and Professional Services, Division of Safety and Buildings Commercial Buildings Plan Review info website for additional information: <http://dsps.wi.gov/sb/SB-HomePage.html>.
- C. For scheduling of building, HVAC, and fire plans, use the electronic online request for commercial building plan appointments: <http://dsps.wi.gov/sb/SB-DivPlanReview.html>
- D. Once approved, Safety and Buildings will retain one of the sets, and will return three sets, which shall be distributed as follows:

1. (1) copy shall be retained by the fire alarm contractor on-site, and shall be used as a reference/made available to any Department of Safety and Professional Services inspectors, who may make periodic inspection visits to the site.
  2. (1) copy shall be forwarded to the Owner for their records.
  3. (1) copy shall be retained by the Division 26 electrical contractor, for their records. If the Division 26 electrical contractor and the fire alarm contractor are the same firm, this copy shall be kept on site, at or near to the Fire Alarm Control Panel.
- E. CITY OF MADISON – FIRE DEPARTMENT INSPECTION/FIRE ALARM WORK PERMIT:
- F. PER A LOCAL ORDINANCE (City of Madison General Ordinance 34 – Fire Prevention Code) EFFECTIVE AS OF JULY 2, 2002 - THE FIRE ALARM AND FIRE PROTECTION SYSTEMS, AS INSTALLED WITHIN THIS FACILITY ARE SUBJECT TO PERMIT REQUIREMENTS AND INSPECTIONS OF THE INSTALLATION BY THE CITY OF MADISON – FIRE DEPARTMENT/FIRE PREVENTION BUREAU:
- G. THE FAC SHALL BE RESPONSIBLE FOR SCHEDULING, COORDINATING, AND ATTENDING THIS INSPECTION, AND FOR PAYMENT OF ALL ASSOCIATED INSPECTION/PERMIT FEES.
- H. This process normally involves both a plan review and inspections; however, for State-Owned Buildings, the City of Madison only performs the inspections, with the Plan Review being performed by COMM/Safety & Buildings as specified previously under “Submittals”.
- I. Copies of the applicable Code can be obtained on-line, via the following link:
1. <http://www.madisonfire.org/prevention/pdf/mgo34.pdf>
- J. Because of this Permit/Inspection process, the following procedure shall be followed by the Division 26 Electrical Contractor, (and by their sub-contractors, where particular arrangements have been made between the EC and their sub-contractor(s)):
1. First, the Electrical Contractor shall obtain State-Approval of the Installation Drawings, per the process previously described under “Submittals – Plan Review Process”, as found within this specification.
  2. Once the State-Approved Drawings are received by the contractor, and PRIOR TO STARTING ANY CONSTRUCTION, the Electrical Contractor shall completely fill-out submit the proper “City of Madison Fire Department – Fire Protection System Work Permit Application” form. If required, suitable fee payment shall accompany the form. Copies of this form may be obtained via the following link:
    - a. [http://www.madisonfire.org/prevention/fire\\_protection\\_engineering/pdf\\_files/master\\_plan\\_review\\_permit\\_application.pdf](http://www.madisonfire.org/prevention/fire_protection_engineering/pdf_files/master_plan_review_permit_application.pdf)
  3. Once the form has been received, processed, and accepted by the Madison Fire Department (MFD), MFD will issue the proper permit, and construction may begin.
  4. The inspection program involves at least two inspections, as follows:
    - a. A Rough-In Inspection shall be scheduled and performed, prior to installation of any new devices. In certain buildings (high-rises), multiple rough-in inspections may be required, as subsequent areas are completed. It is highly recommended that these inspections should be carefully scheduled and adhered to, since potentially costly mistakes can be prevented before the associated devices are completely installed.
    - b. Final Inspection of the System – prior to this inspection, the Electrical Contractor shall have conducted all necessary pre-testing.
    - c. Questions regarding this inspection program may be directed to:  
 City of Madison – Fire Department – Fire Prevention Bureau  
 325 West Johnson Street  
 Madison, WI 53703  
 Phone: (608) 266 – 4420 (Non-Emergency Number)

#### **1.16 PROJECT RECORD DRAWINGS**

- A. Installing Electrical Contractor shall submit to the Construction Superintendent the as-built drawings for the entire work done under this project prior to final payment.
- B. Work shall be done on Auto CAD using the contract drawings provided to the Contractor by Owner in the form of Auto CAD files. A hard copy of same shall also be submitted.
- C. These drawings shall show:
  1. Locations and addresses of Initiation Devices, Notification Appliances, isolation devices, status-monitoring devices, supervised signaling devices, and auxiliary control devices.



2. Circuit and Address information for each field device listed above.
  3. Conduit layout and size
  4. Number/size/type of conductors in each conduit run
  5. Riser diagrams
  6. Location of end-of-line devices
- D. Riser diagrams shall include location of 120VAC panel, panel designation and circuit number used to feed each fire alarm panel. Also, indicate if panel is backed up by an emergency generator.
  - E. Riser diagrams shall include locations (room or area number) of notification, initiating, end-of-line devices and addresses for all addressable field devices.
  - F. Also see requirements in Division 1, General Conditions.

#### **1.17 SPARE PARTS**

- A. Contractor shall provide the following spare parts in quantities shown:
 

Quantity:	Type of Device
(1)	Photoelectric smoke detectors
(1)	Smoke and heat detector bases – “standard” 2-Wire Type
(1)	Monitor Module (of each type utilized in this project)
(3)	Ceiling-Mount multi-candela Speaker/strobe Units.
(1)	Pull Stations

#### **SUPERVISION**

- B. The system shall report a TROUBLE condition when any supervised circuit becomes disarranged, disconnected, or is manually disabled or overridden. Each supervised circuit shall be independently protected for short-circuit conditions, and shall be arranged so that faults on any one circuit do not prevent the proper operation of any other circuit in the system.
- C. The following devices/circuits shall be supervised, as a minimum:
  1. ALL communications links.
  2. ALL Signaling Line Circuits
  3. ALL Initiating Device Circuits.
  4. All sprinkler flow and tamper switches..
  5. ALL Notification Appliance Circuits.
  6. Auxiliary manual control circuits.
  7. Remote Control Relays/Control Modules.
  8. Primary, AC Incoming power to the system.
  9. The system's batteries.
  10. System Expansion Modules
  11. Auxiliary module LED's.
- D. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.
- E. Each independently supervised circuit shall include a discrete LCD readout, to indicate disarrangement conditions per circuit.

#### **1.18 POWER REQUIREMENTS**

- A. Primary 120 VAC power, to all Fire Alarm equipment shall consist of dedicated branch circuits. These circuits shall be of a 3-conductor type, including a suitably sized green ground wire – SHARED NEUTRALS AND CONDUIT GROUNDS SHALL BE UNACCEPTABLE.
- B. Each control panel shall receive 120 VAC power via a branch circuit in one of the building's emergency load panels. Each such branch circuit shall have a "breaker lock" to prevent accidentally de-energizing of the power to the fire alarm panel. Circuit breakers shall be painted red and labeled "FIRE ALARM". If more than one power circuit is used, each circuit shall be properly labeled as “FIRE ALARM”, and shall also be labeled with additional information – in order to indicate which fire alarm equipment is powered from each such circuit.
- C. All fire alarm power supplies, as well as any other supplemental power supplies, shall be installed in compliance with NFPA-70 – National Electrical Code (Latest Edition).
- D. The panel shall include a disconnect switch for the AC power inside a locked enclosure near the panel or within the panel itself. This switch shall be labeled “Fire Alarm Power Disconnect”.

- E. The control panel shall include 120 VAC electrical power surge and transient protection. If problems are anticipated, due to electrical transients associated with periodic generator testing, then the fire alarm equipment supplier shall provide suitable power filtering/suppression equipment, as recommended by the equipment manufacturer.
- F. The system shall include sufficient back-up battery capacity to operate the entire system as follows, upon loss of normal 120 VAC power:
  - 1. For panels, which are not connected to Dedicated Emergency Power (no Generator) Branch Circuits:
    - a. The Panel and associated devices shall operate in a normal (non-Alarm) mode for a period of 24 Hours. After the 24-Hour normal period has expired, sufficient capacity shall remain, such that the panel and associated devices shall operate in an Alarm mode (All Speakers EVAC) for a period of 10 minutes.
- G. The panel shall include a power-limited, filtered and regulated battery charger. The charger shall charge a fully discharged battery to 70% in 12 hours. The panel shall monitor for AC fail/disconnect, low/no battery and high battery and shall distinctly display or annunciator any abnormality. The main panel power supply shall include sufficient power to power all connected field devices and an additional 25% spare power for future additions without the need to add additional boards or booster power supplies. The charger shall be designed specifically for, or shall be properly configured for the provided batteries, which shall be of one of the following types:
  - 1. Sealed, Immobilized Electrolyte Lead-Acid type (“Gel-Cells”) – Types which require fluid level maintenance, or which vent significant amounts of Hydrogen shall be unacceptable.
  - 2. Nickel-Cadmium (Ni-Cad) batteries.
- H. All batteries used in conjunction with the fire alarm system shall be installed in accordance with NFPA-70 – National Electrical Code (Latest Edition).
- I. If these batteries are not located within or immediately adjacent to the fire alarm equipment, the location of such batteries shall be clearly indicated within the fire alarm equipment served by them, and the batteries and their enclosure shall be clearly marked as “FIRE ALARM”
- J. All external circuits requiring system-operating power shall be 24VDC and shall be individually supervised and fused at the control panel.

## **PART 2 – PRODUCTS**

### **2.01 MANUFACTURER**

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Edwards, United Technologies
  - 2. Notifier
  - 3. Siemens
  - 4. Simplex
  - 5. Gamewell FCI
  - 6. Honeywell, Farenhyt Series

### **2.02 ENCLOSURES**

- A. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component.
- B. Cabinet shall be equipped with locks and transparent door panel providing tamper proof enclosure yet allowing full view of the various lights and controls as required above.

### **2.03 MULTIPLEX/INTELLIGENT FIRE ALARM CONTROL PANEL (FACP):**

- A. A Multiplex intelligent fire alarm system shall be installed within the new concessions and Room 100.. This building shall be provided with a minimum of one Fire Alarm Control Panel (FACP), as shown on the project drawings.
- B. The control Panel shall be modular, expandable with solid state, microprocessor based electronics. It shall display through the front viewing window only those primary controls and displays essential to operation during a fire alarm condition.
- C. The fire alarm system shall allow for loading and editing special instructions and operating sequences as required. Software programming shall allow for full flexibility for selective input/output control

functions based on the Boolean programming functions AND, OR, NOT, as well as, timing, and special coded operations. The system shall be able to use all of the above programming functions in combination with any number of inputs and outputs. The systems shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.

- D. Simple Addressable systems, which do not support Analog Addressable or Intelligent Addressable detection technology shall also be unacceptable.
- E. The control panel shall provide the following as standards:
  - 1. Analog Addressable or Intelligent Addressable Detection, supporting the following:
    - a. Drift compensation
    - b. Sensitivity display in %
    - c. Sensitivity adjustment
    - d. Day/night sensitivity adjustment
    - e. Auto Detector test to meet NFPA 72
    - f. Alarm verification with tally counter
    - g. Maintenance alerts
  - 2. The number of Signaling Line Circuits (SLCs) required for the specified quantity of addressable field devices and peripherals, plus one (1) spare loop (SLC) for each five (5) active loops. Each active loop shall include 10% spare capacity or a minimum of 10 additional devices.
  - 3. The number of Audible Notification Appliance Circuits (Speaker NACs) required for the specified quantity of speakers plus one (1) spare circuit for each ten (10) active circuits. Each active circuit shall include 25% spare capacity
  - 4. The number of Visual Notification Appliance Circuits (Strobe NACs) required for the specified quantity of strobes plus one (1) spare circuit for each ten (10) active circuits. Each active circuit shall include 25% spare capacity or a minimum of (4) 110 cd devices that can be added in the future.
    - a. 80-character liquid crystal display.
    - b. Printer interface
    - c. History log file with a minimum of 800 events
    - d. Field programmability
    - e. Silent walk test
- F. The multiplex/intelligent system shall provide the ability to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history.
- G. The LCD shall display the following information relative to the abnormal condition of a point in the system prior to acknowledgement:
  - 1. 40 characters for:
    - a. Point address and loop number (i.e. 555-L5)
    - b. Type of device (i.e. smoke sensor, pull station, water-flow)
    - c. Point status (i.e. alarm, trouble)
  - 2. 40 characters for:
    - a. Custom location label (i.e. 4th Floor - Room 444)
- H. Keyboards or keypads shall not be required to operate the system during fire alarm conditions.
- I. The following software functions shall be provided, from the built-in system keyboard/display:
  - 1. Setting of time and date
  - 2. LED testing
  - 3. Alarm, trouble, and abnormal condition listing
  - 4. Enabling and disabling of each monitor point separately
  - 5. Activation and deactivation of each control point separately
  - 6. Changing operator access levels
  - 7. Walk Test enable/disable
  - 8. Running diagnostic functions
  - 9. Displaying historical logs
  - 10. Point listing
- J. The following hardware switches/functions shall be provided within the main panel enclosure:
  - 1. Acknowledge alarm or trouble
  - 2. Silence alarm or trouble

3. Reset system after alarm
  4. Connect/disconnect Central Monitoring tie
  5. Provide manual evacuation (drill)
  6. Bypass elevator interface
  7. Bypass AHU/Fan Interface
  8. Bypass door holders
  9. Switches not applicable to this building shall still be provided in the stated quantity along with (2) additional switches for future expansion. These additional switches as well as any switches not utilized would not be initially programmed and would be label unused.
- K. STATUS INDICATORS AND DISPLAYS
1. A local audible device shall sound during Alarm, Trouble or Supervisory conditions. This audible device shall also sound during each key-press to provide an audible feedback to ensure that the key has been pressed properly.
  2. The 2-line by 40-character liquid crystal display shall be backlit for enhanced readability.
  3. A cursor shall be visible on the LCD when entering information.
    - a. Scrolling through menu options or lists shall be accomplished in a self-directing manner in which prompting messages shall direct the user
- L. CONTROLS
1. The following controls shall be accessible with the front door open.
    - a. Manual evacuation (drill)
    - b. EVAC Microphone, and associated Audio Controls and Indicators
    - c. LED/LCD Test Switch
    - d. Key pad for data input and microprocessor control
    - e. Bypass Function Switches and LEDs for the following. Mark unused future if not applicable:
      - 1) Central Monitoring Bypass
      - 2) Future Programmable Switch #1
      - 3) Future Programmable Switch #2
- M. LED SUPERVISION
1. All slave modules LEDs shall be supervised for burnout or disarrangement
- N. ACKNOWLEDGMENT
1. Two methods of acknowledgment for each abnormal condition shall be provided. One may be chosen depending on the NFPA requirements.
  2. First method - Acknowledge one event at a time from an unacknowledged list of events:
    - a. Pressing the appropriate acknowledge button shall display the first unacknowledged condition in the appropriate list (either alarm, supervisory or trouble), and require another acknowledge button. Press to acknowledge only the displayed point.
    - b. After all points have been acknowledged, the LEDs shall glow steadily and the Sonalert will be silenced. The total number of alarms, supervisory and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated by an end of list message "END of LIST".
  3. Second method- Pressing the appropriate acknowledge button shall globally acknowledge all points.
- O. SILENCING
1. If an alarm condition exists and the "Alarm Silence" button is pressed, all alarm audio and visual notifications appliances shall cease operation.
  2. If trouble conditions exist in the system and the "Trouble Silence" button has been pressed, the aural trouble signal shall cease, but shall resound at time intervals to act as a reminder that the fire alarm system is not in a normal operating mode. Both the time interval and the trouble reminder signal shall be programmable to suit the Owner's application.
- P. RESET
1. The SYSTEM RESET button shall be used to return the system to its normal state after an alarm condition has been remedied.
  2. Should the Alarm Silence Inhibit function be active, the system shall ignore all key presses. An indication of enabling and disabling the inhibit state shall be provided as a feedback to the operator.
- Q. BYPASS FUNCTIONS
1. Provide a switch for each item as shown below. Switches not applicable to this building would be provided, but left non programmed and labeled and unused.

2. Bypass Switches shall be configured such that whenever any bypass function is active, a Trouble status condition shall be reported by the system, per the Trouble Sequence. The trouble message shall indicate the active function(s). Bypass LEDs shall be configured such that LEDs corresponding to the active function(s) shall illuminate, and shall remain lit until the associated bypass function is deactivated (until the system is restored to normal operating status). Switches and LEDs shall be provided for the following functions
  - a. Central Monitoring Bypass - When this bypass function is active; reporting of various status conditions to the reporting system shall be disabled.

R. ACCESS TO OPERATOR FUNCTIONS:

1. The following Operator Function Access Restrictions shall be adhered to as closely as possible. Where system limitations do not allow for the restrictions to be configured exactly as listed, alternate methods will be considered, and shall be brought to the attention of the Engineer prior to bidding:
  - a. ACCESS LEVEL 1 - BASIC OPERATOR FUNCTIONS:
    - 1) ACKNOWLEDGE – allows Basic Operators to acknowledge ALARM, TROUBLE, and SUPERVISORY conditions, and to view the lists/logs associated with these functions.
    - 2) SIGNAL SILENCE – allows Basic Operators to silence the audible and visual signals. The system shall not permit signals to be silenced during “alarm silence inhibit mode” (if “Inhibit Mode” is utilized).
    - 3) SYSTEM RESET – allows Basic Operators to Reset the Fire Alarm System. The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been remedied. The LCD display shall step the user through the reset process with simple English language messages.
  - b. ACCESS LEVEL 2 - HIGH SECURITY FUNCTIONS:
    - 1) Changes to the linkage of Operator Functions to Access Level/Pass-Code Profiles may affect the ability of individuals to access required functions. Because of this, access to this linking function shall also be appropriately secured.
  - c. ACCESS LEVEL 3 - OTHER FUNCTIONS:
    - 1) These functions shall include, but shall not be limited to:
      - a) Enable/Disable Points
      - b) Perform “Override” Functions/Features
      - c) Generate Hard-Copy, Printed Reports
      - d) Add/Delete/Change Pass codes, and associated links to system features
      - e) Set/Change System Clock
      - f) Set/Change Sensitivity of Detectors
      - g) Clear History Logs

S. POINT LISTING

1. All points list by address
2. Monitor point list
3. Signal/speaker list
4. Auxiliary control list
5. Feedback point list

T. HISTORY LOGGING

1. The system shall be capable of logging and storing the last 800 events (alarm & trouble) in a history log. These events shall be stored in a battery protected random access memory.
2. The following historical alarm/trouble log events shall be stored:
  - a. Alarms
  - b. Alarm Acknowledgment
  - c. Alarm Silence
  - d. System Reset
  - e. Alarm Historical log cleared
  - f. Trouble conditions
  - g. Supervisory alarms
  - h. Trouble acknowledgment
  - i. Supervisory acknowledgment
  - j. Alarm Verification tallies
  - k. Walk Test results

1. Trouble Historical log cleared
- U. SILENT WALK TEST WITH HISTORY LOGGING
1. The system shall be capable of being tested by one person. While in testing mode the alarm activation of an alarm-initiating device shall be silently logged as an alarm condition in the historical data file. The panel shall automatically reset itself after the logging of the alarm.
  2. The momentary disconnection of an initiating or indicating device circuit shall be silently logged as a trouble condition in the historical data file. The panel shall automatically reset itself after logging of the trouble condition.
  3. Should the silent walk-test feature be on for an inappropriate amount of time (30 minutes max.) it shall revert to the normal mode automatically.
  4. The panel shall have the capability of dividing the system into distinctive walk test groups, a minimum of 8 groups.
  5. Should an alarm condition occur from an active point, not in walk test mode, it shall perform operations described above.
  6. After testing is considered complete, testing data may be retrieved from the system in chronological order to ensure device/circuit activation.
- V. WATCH-DOG TIMERS
1. The system shall include independent "Watch-Dog" timers to detect and report failure of any microprocessor circuit, memory, or software.
- W. FIELD PROGRAMMING
1. The system shall be fully programmable, configurable, and expandable in the field without the need for special tools or PROM programmers and shall not require replacement of memory IC's. All programming may be accomplished through the standard control panel keyboard or a keyboard at the printer, or the use of a PC. All programs shall be stored in non-volatile memory.
  2. All programming or reprogramming shall be done by the supplier at no charge until the owner accepts the system.
- X. SOFTWARE MODIFICATIONS
1. The system shall be capable of being programmed by means of a Field Configuration Program (FCP) allowing programming to be downloaded via portable computer from any node on the network.
  2. Provide the services of a factory trained and authorized Technician to perform all system software modifications, upgrades, or changes. Response time of the Technician to the site shall not exceed 4 hours.
  3. Should the Owner have a factory trained and authorized technician on staff, provide all hardware, software, programming tools, access codes, and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones, and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.
  4. If the system access code is either a hardware key or a software key, the Contractor/Vendor shall provide the proper key to meet the above requirements."
- Y. TERMINAL/PRINTER INTERFACE
1. Fire Alarm Control Panel shall be capable of operating remote Command Center and printers.
  2. Each output shall be ASCII, from an EIA RS-232-C serial data connection with an adjustable baud rate.
  3. A minimum of one such RS-232 port shall be provided.
  4. Each RS-232-C port shall be capable of being configured for either a CRT or a printer.
    - a. One such port shall be configured for a supervised connection to the Fire Alarm System printer.
    - b. One such port shall be configured for non-supervised connection to the CRT or Laptop.
- Z. SIGNALING LINE CIRCUITS:
1. The system must provide communications with intelligent addressable initiating and control devices individually. These devices shall be individually annunciated at the control panel [and FAAP] [and RFCC]. Annunciation shall include the following conditions for each point:
    - a. Alarm
    - b. Trouble
    - c. Open

- d. Short
- e. Device missing/failed
- 2. All intelligent addressable initiation and control devices shall have the capability of being disabled or enabled individually.
- 3. Systems that require factory pre-programming or EPROMs to add or delete devices shall be unacceptable.
- 4. The communication format must be a completely digital poll/response protocol to allow t-tapping of the Signaling Line Circuit wiring. Systems that do not utilize full digital transmission protocol are not acceptable.
- 5. Special-purpose Isolator devices shall be used to provide further isolation/protection of sections of the Signaling Line Circuits. Areas served by Signaling Line Circuits shall be isolated as specified within the "scope" portion of this specification. The following Isolation devices shall be acceptable for use in performing this function:
  - a. Isolator Modules – Field Mounted.

**2.04 OPERATION: MULTIPLEX/INTELLIGENT FIRE ALARM SYSTEM**

**A. PRIORITY:**

- 1. Fire Alarm status conditions shall have the highest priority.
- 2. Supervisory status conditions shall have the second highest priority.
- 3. Trouble status conditions shall have the lowest priority.

**B. STAND-BY MODE:**

- 1. Under normal condition the front panel shall display a "System is Normal" message and the current time and date

**C. SYSTEM RESPONSE**

- 1. The time delay between the Alarm activation of an initiating device, and the automatic activation of the Notification Appliances and the annunciation of the Alarm status condition at the FACP and annunciators shall not exceed 5 seconds.
- 2. For response-time purposes, the manual actuation of an Audio Control Switch - associated with the one-way voice communications system - shall be instantaneous and shall be treated as if it were manual alarm activation.

**D. ALARM SEQUENCE:**

- 1. The following events are not required to occur in the stated order. However, ALL automatic responses must be initiated within the time interval allotted by UL and NFPA codes and standards.
- 2. This "Fire Alarm Sequence" shall be initiated upon receipt of one of the following, valid Fire Alarm status conditions:
  - a. Actuation of any Manual Pull Station, any Fire Protective Sprinkler System, any other Automatic Fire Suppression System, from any Smoke Detector
- 3. The system alarm operation, subsequent to the activation of any of the conditions listed above, shall be as follows:
  - a. The EVAC System shall automatically initiate "EVAC" Mode. All audible notification appliances (Speakers) [within the building] [within the affected Notification Area(s)] shall sound, using a sequence that is compliant with NFPA-72 – including an Alert Tone and a Digital Voice Message. The Alert Tone and Digital Message shall be repeated a minimum of three times, and shall continue to be repeated until the Audible Notification Appliances are Silenced, until a Manual Announcement is Made, or until the system is Reset.
  - b. All visual notification appliances within the building shall flash continuously until the system is acknowledged.
  - c. Any subsequent alarm shall reactivate the alarm audible and visual notification appliances within the building
  - d. The system Alarm LED shall flash on the FACP and the FAAP, until the alarm has been acknowledged. Once acknowledged, this same LED shall latch on.
  - e. A subsequent alarm received from another device shall flash the system alarm LED on the FACP and the FAAP. The LCD display shall show the new alarm information.
  - f. A pulsing alarm tone shall occur within the FACP and the FAAP until the event has been acknowledged.

- g. The system shall have a single key that will allow the operator to display all alarms, troubles, and supervisory service conditions including the time and date of each occurrence.
  - h. A programmed Alarm Message shall appear on the FACP and the FAAP LCD displays. These field programmable messages shall be revised, as directed by the Owner, during shop drawing review. The alarm shall be displayed on an 80-character LCD display as follows:
    - i. 40 characters for:
      - 1) Point address and loop number
      - 2) Type of device
      - 3) Point status
    - j. 40 characters for:
      - 1) Custom location label
- E. AUTOMATIC ALARM VERIFICATION:
- 1. The initial Alarm activation of any system smoke detector shall initiate an alarm verification operation whereby the panel will reset the activated detector and wait for a second alarm activation. If, after (20) seconds and within (30) seconds after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within (30) seconds, the system shall resume normal operation. The alarm verification shall operate only on single smoke detector alarm. Other activated initiating devices or multiple smoke detector alarms shall be processed and reported immediately.
  - 2. The alarm verification operation shall be selectable by device or by group for addressable detectors and by IDC for non-addressable smoke detectors. Automatic Alarm Verification shall be enabled for all smoke detectors [including resident room smoke detectors if they are connected to the fire alarm system].
- F. SELF-TEST AND AUTOMATIC DRIFT COMPENSATION:
- 1. The control panel shall continuously perform an automatic self-test routine on each Smoke Detector, which will functionally check detector electronics and ensure the accuracy of the values being transmitted to the control panel. Any detector that fails this test shall indicate a "SELF TEST FAILED" trouble condition with the detector location at the control panel.
  - 2. All Intelligent Addressable Smoke Detectors used on this project shall incorporate automatic drift compensation/automatic sensitivity monitoring and adjustment, as described within the "definitions" portion of this specification section.
- G. OPERATOR INTERFACE/MAINTENANCE FEATURES FOR AUTOMATIC SMOKE DETECTION:
- 1. An operator at the control panel shall have the capability to manually access the following information for each detector:
    - a. Primary status
    - b. Device type
    - c. Present average value
    - d. Present sensitivity value selected
    - e. Peak detection values
    - f. Detector range (normal, dirty, etc.)
  - 2. Values shall be in "percent of smoke obscuration" format so that no interpretation is required by the operator.
  - 3. An operator at the control panel shall have the capability to manually control the following for each detector:
    - a. Clear peak detection values
    - b. Enable or disable the detector
    - c. Clear verification tally
    - d. Establish alarm sensitivity
    - e. Control a detector's relay driver output
  - 4. It shall be possible to program the control panel to automatically change the sensitivity settings of each detector based on time-of-day and day-of-week.
  - 5. The control panel shall clear a "Detector dirty" trouble after a detector has been removed from its base cleaned and replaced.
- H. SPRINKLER SYSTEM SUPERVISORY SERVICE
- 1. The control panel shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.



2. The activation of any standpipe or sprinkler valve supervisory (tamper) switch shall activate the system supervisory service audible signal and illuminate the LED at the control panel and FAAP. The panel shall provide differentiation between valve tamper activation and opens and/or grounds on the initiation circuit wiring.
  3. Pressing the supervisory service acknowledge key will silence the supervisory audible signal while maintaining the supervisory service LED "on" indicating the off-normal condition.
  4. Restoring the valve to the normal position shall automatically reset the tamper indication.
- I. TROUBLE SEQUENCE:
1. Disarrangement, disconnection, Power Failure, or malfunction of any supervised feature(s)/components of the System shall cause actuation of the following sequence of events:
    - a. A SYSTEM TROUBLE or POINT TROUBLE status condition shall be both audibly and visually indicated at the Fire Alarm Control Panel (FACP) [and FAAP] [and the RFCC] in a way which differentiates the TROUBLE status clearly from an ALARM. Audible indication shall cease, once the TROUBLE has been acknowledged.
    - b. In addition, a programmed message, similar in nature to the ALARM "Custom Labels", shall appear on the FACP and FAAP. (Default messages, if TROUBLE Detector/Sensor/Module Point Messages are associated with ALARM messages, shall be acceptable.)
    - c. The Trouble status condition shall also be Visually and Audibly indicated at all appropriate Network Annunciators and at the Fire Alarm Network Computer. This indication shall be essentially identical to the Audible, Visual, and Alphanumeric display at the FACP and FAAP except that additional information shall be incorporated, to indicate the building of origin.
    - d. A "Trouble Reminder" Feature, which causes the FACP to re-sound the TROUBLE indicators when System/Point TROUBLE conditions remain on the system, shall be enabled, and shall be set to re-sound every twelve (12) hours.
    - e. Subsequent Troubles shall cause the FACP and FAAP TROUBLE LEDs and sounders to re-sound, along with the "Custom Label" and other information related to the "new" TROUBLE condition.
- J. MANUAL DRILL
1. A manual evacuation (drill) switch shall be provided to operate the alarm indicating appliances without causing other control circuits to be activated.
- K. LED AND LCD TEST
1. Activation of the Lamp Test switch shall turn on all LED indicators, LCD display, and the local sounder and then return to the previous condition.
- L. SYSTEM DIAGNOSIS
1. The system shall include special software to detect, diagnose and report failures and isolate such failures to a printed circuit board level.
- M. SILENT WALK TEST WITH HISTORY LOGGING
1. The actuation of the "Walk Test" switch/program at the control panel shall activate the "Walk Test" mode of the system, which shall cause the following to occur:
    - a. The Output Contacts, which provide the interface to the Fire Alarm System Reporting shall be bypassed.
    - b. Control relay functions shall be bypassed, such as door holders, elevator capture, fan shut down, etc.
    - c. The audio and visual circuits shall be bypassed.
    - d. The control panel shall show a trouble condition.
    - e. The alarm activation of any initiation device shall be silently logged as an alarm condition in the historical data file. The panel shall automatically reset itself after the logging of the alarm.
    - f. Any momentary opening of an initiating or indicating appliance circuit shall be silently logged as a trouble condition in the historical data file.
    - g. The panel shall automatically reset itself after logging of the trouble condition.
    - h. If the system becomes inactive for a period of longer than 10 minutes the panel shall default to normal fire alarm functions.
  2. The panel shall be programmed to consist of a minimum of (?) distinctive walk test groups as follows:
  3. It shall not be required to manually restart or reboot the fire alarm panel after a silent walk test is completed.

## **2.05 CENTRAL MONITORING**

- A. The new Fire Alarm System shall be interfaced to the following systems utilizing existing copper connection, for remote reporting.
- B. The interface between the reporting system(s) listed above and the new Fire Alarm System shall be configured as follows:
- C. Required relay (contact) outputs:
  - 1. Fire Alarm: This contact shall actuate in response to any Fire Alarm status condition, other than Sprinkler Water Flow.
  - 2. Water Flow Alarm: This contact shall actuate only in response to Fire Alarm status Conditions, which are due to Sprinkler Water Flow.
  - 3. Sprinkler Supervisory: This contact shall actuate in response to actuation of any Valve Tamper Switch associated with the Fire Protective Sprinkler System.
  - 4. System Trouble: This contact shall actuate in response to the occurrence of any Trouble status condition on the Fire Alarm System.
- D. The Contractor installing the new Fire Alarm Systems shall be responsible for coordination of the Fire Alarm System connections to these system(s), for all wiring and conduit between these system(s), and for all terminations at the Fire Alarm end of such interface wiring. All such wiring, raceway, and terminations shall be included per the Base Bid.

## **2.06 OPERATION: ONE- WAY VOICE COMMUNICATIONS**

- A. The One-Way Voice Communications sub-system shall function as an Emergency Voice Area Communications (EVAC) System, as defined within NFPA-72. This system shall be equipped with a Single-Channel, selective EVAC sub-system.
- B. As a Selective EVAC system, any message being broadcast shall always be broadcast to the selected areas only.
- C. The One-Way Voice Communications System, as specified for this project, is intended to perform two primary types of functions:
  - 1. AUTOMATIC FIRE ALARM FUNCTION SUMMARY
    - a. In the event of a Fire Alarm, this system shall automatically generate an Alert Tone and Digital Voice Message, and shall automatically broadcast and repeat this tone throughout [the building] [pre-selected Notification Areas]. This function is intended to notify the occupants that they need to leave the building.
  - 2. MANUAL VOICE FUNCTION SUMMARY
    - a. The intended purpose of the voice capabilities of the system are to provide an approved means for manually announcing supplemental evacuation instructions, and for other Emergency notifications.
    - b. The new Fire Alarm System shall be provided with suitable means to generate Manual EVAC messages from the following four locations:
      - 1) From the Master EVAC microphone, located within or adjacent to the FACP.
- D. The FACP and FAAP shall be equipped with programmed Control Switches and LEDs, for all manually selectable functions. These switches and LEDs shall be clearly labeled, in order to indicate the functions associated with them, or the status conditions, which they indicate.
  - 1. Such switches and LEDs shall be configured for selection of the various modes. Whenever a Notification Area is manually selected, LEDs located adjacent to the control switches shall illuminate in a distinctive manner, and a Trouble status condition shall be logged by the system. The Trouble status condition shall remain until all control switches are manually or automatically reset to their normal positions.
  - 2. ["In-Use" Status LEDs shall be provided, as follows:]
    - a. At the FACP, an LED shall be provided, which shall indicate "FAAP IN USE". This LED shall illuminate, whenever any EVAC or Override /Bypass function has been selected at the FAAP
    - b. At the FAAP, an LED shall be provided, which shall indicate "FACP IN USE". This LED shall illuminate, whenever any EVAC or Override/Bypass function has been selected at the FACP .
- E. In conjunction with the two primary functions of this sub-system, and because this system is intended to provide selective manual functions, the system shall provide a minimum of the following Modes of operation:
  - 1. EVACUATION - AUTOMATIC MODE:

- a. In most cases, the One-Way Voice Communications sub-system shall function automatically as a tone generator and Digital Message Generator. Whenever Automatic EVAC Mode is triggered, the system shall function according to the system programming. The Fire Alarm System shall be programmed such that this Mode shall ALWAYS be accompanied by simultaneous operation of ALL Visible Notification Appliance Circuits, within the active Notification Areas.
    - 1) The actual sequence, signal tone, and digital voice message utilized by Automatic Mode shall be compliant with the latest edition of NFPA-72. Currently it is 3-12.6.3.1(a) (1996 Edition), and the tone and message shall be repeated automatically, until one of the following occurs:
      - a) Until the Audible Notification Appliances are Manually Silenced.
      - b) Until a Manual Talk Mode is selected.
      - c) Until the Fire Alarm System is Reset.
    - b. The sequence shall include a back-up tone generator, which operates in compliance with the latest edition of NFPA-72. Currently it is 3-12.6.3.2 (1996 Edition) in the event of failure of the primary tone/message generator.
    - c. Pressing the “Signal Silence” switch, at either the FACP or FAAP shall cause the audible and visual notification Appliances to cease operation.
    - d. All Visual Notification Appliances shall continue to flash until the system is reset.
  - 2. MANUAL EVACUATION – ALL SPEAKERS MODE:
    - a. This mode shall only be initiated manually. Manual Evacuation mode shall be initiated by means of programmed Control Switches and LEDs. These switches and LEDs shall be appropriately labeled, in order to indicate their function.
    - b. Actuation of this mode shall not require the existence of a Fire Alarm status condition. This mode may be used for other Emergency Evacuation Notifications.
    - c. Whenever “Manual Evacuation – All Speakers” Mode is selected, the following shall occur:
      - 1) The Audio Sub-System shall broadcast the evacuation tone (Temporal Pattern) through All Audible Notification Appliances, and shall actuate all Visual Notification Appliances.
      - 2) If a Fire Alarm status condition does not exist, re-setting the Notification appliances shall be accomplished by setting all switches back to the normal (inactive) positions and/or by resetting the system.
      - 3) If a Fire Alarm Status condition occurs while “EVACUATION - MANUAL MODE” is active, all other required actions – such as AHU shutdown and Door Holder release, shall be initiated.
  - 3. MANUAL TALK MODE – ALL SPEAKERS:
    - a. This mode shall only be initiated manually. This mode shall be initiated by means of programmed Control Switches and LEDs. These switches and LEDs shall be appropriately labeled, in order to indicate their function.
    - b. Actuation of this mode shall not require the existence of a Fire Alarm status condition. This mode may be used for other Emergency Evacuation Notifications.
    - c. Whenever “Manual Talk – All Speakers” Mode is selected, the following shall occur:
      - 1) An Alert/Warning Tone shall be broadcast through all system speakers for approximately two seconds. The purpose of this tone is to warn occupants that a manual voice message is about to be announced. At the end of this Alert/Warning Tone, messages spoken into the system microphone shall be broadcast through All Audible Notification Appliances.
      - 2) All Visual Notification Appliances shall be activated upon selection of this mode, and shall remain in operation until this mode is de-activated.
      - 3) If a Fire Alarm status condition does not exist, re-setting the Notification appliances shall be accomplished by setting all switches back to the normal (inactive) positions and/or by resetting the system.
      - 4) If a Fire Alarm Status condition occurs while “Manual Talk – All Speakers” Mode is active, all other required actions – such as AHU shutdown and Door Holder release, shall be initiated.
      - 5) If “Manual Talk – All Speakers” Mode is initiated during a Fire Alarm status condition, ALL Visible Notification Appliances shall continue to flash, until the system is silenced.
- F. “DEAD-MAN” TONE:
- 1. The system shall automatically default to the Automatic Evacuation Mode, and shall broadcast the evacuation tone to the entire facility (tone generator/temporal pattern) if a manual talk mode is selected

during an ALARM mode or an ALARM condition occurs while the manual talk mode was selected, and the microphone becomes inactive for more than one (1) minute.

**2.07 NAC BOOSTER PANELS (REMOTE POWER SUPPLIES):**

- A. Where they are used, "NAC Power Booster Panels" shall be individually supervised. Interconnecting NAC Booster Panels in a manner, which prevents identification of individual panel TROUBLE conditions, shall not be approved.
- B. If NAC Booster Panels are needed at locations other than those identified on the construction drawings, the Electrical Contractor shall obtain approval for their proposed installation locations. At such locations, the EC shall provide any required circuit breakers, associated power wiring, and local smoke detection at the approved location. Power shall be obtained from the nearest available emergency panel. The cost of such equipment and installation shall be included within the base Electrical Bid.

**2.08 MULTIPLEX/INTELLIGENT PERIPHERAL DEVICES**

- A. All devices shall be supervised for trouble conditions. The system control panel shall be capable of displaying the type of trouble condition (open, short, device missing/failed). Failure of a device shall not hinder the operation of other system devices.
- B. **DEVICE IDENTIFICATION**
  - 1. Each intelligent device must be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address shall not be acceptable.
  - 2. Device addressing schemes which use permanently-imbedded, electronically-identifiable "serial number" which is similar to the address imbedded within Personal Computer Network Interface Cards shall be acceptable.
  - 3. Fire Alarm Systems utilizing hand-held or briefcase-style programming tools. Which are used to electronically assign addresses and/or programming parameters to devices shall be acceptable. However one such programmer tool shall be provided to the Owner at no additional cost.
  - 4. The address along with the loop number and end-of-line device if present shall be indicated, and be visible from the ground, on the device in the field using machine generated marking. Contractor shall provide a sample of such labeling scheme before using it.
  - 5. End-of Line devices shall also be identified by means of permanent, machine generated label, affixed to the device.
  - 6. Device identification schemes that do not use uniquely set addresses but rely on electrical position along the communication channel are unacceptable. These systems cannot accommodate tapping and the addition of an intelligent device between existing devices requires re-programming all existing devices beyond added device.
  - 7. The system must verify that proper type device is in place and matches the desired software configuration.
- C. **INTELLIGENT DETECTORS - GENERAL**
  - 1. Smoke detectors must be approved by the State Engineer prior to installation.
  - 2. Each detector shall incorporate the following features:
    - a. LED(s), which shall flash to indicate communication with the Fire Alarm System, and which also illuminate in a steady manner when the detector is in an alarm status
    - b. A means to allow field function testing of the detector
    - c. A low-profile design/shape
    - d. An insect screen
    - e. Voltage and RF transient suppression techniques, in order to minimize false alarms
    - f. Smoke detectors shall communicate the actual smoke chamber values to the system control panel.
  - 3. Smoke detectors shall be listed for sensitivity testing from the control panel. Sensitivity test results shall be logged and downloaded to a printer.
  - 4. The detectors shall be plug-in units, which mount to a common base, and shall be UL 268 approved.
  - 5. Each detector shall be compatible with the fire alarm panel and shall obtain its operating power from the SLC, to which it is connected. (Where relay or sounder-equipped bases are used, it shall be acceptable to require a separate 24 VDC or NAC connection.) Each detector shall be reset by actuating the control panel reset switch.
  - 6. If field conditions so require the smoke detection devices shall not be installed until the construction is completed.

#### D. INTELLIGENT DETECTOR BASES

1. Bases shall be suitable for either smoke or heat detector mounting.
2. Either the base or the head shall contain electronic circuits that communicate the detector's status (normal, alarm, sensitivity status, trouble, etc.) to the control panel over two wires. The same two wires shall also provide power to the base and detector. Contacts between the base and head shall be of the bifurcated type using spring-type, self-wiping contacts.
3. The base shall be lockable. The locking feature must be field-removable when not required.
4. Upon removal of the detector's head, a trouble signal shall be transmitted to the control panel.
5. The detector base shall be sealed against rear airflow entry.
6. Each detector's base or head shall contain LED(s), which shall flash when the detector is being scanned by the control panel. The LED(s) shall turn on steady when the detector is in an alarm condition.

#### E. INTELLIGENT PHOTOELECTRIC SMOKE DETECTORS

1. The detectors shall contain no radioactive material.
2. Detectors shall be of the solid state photoelectric type and shall operate on the light scattering photodiode principle using a pulsed infrared LED light.

#### F. ADDRESSABLE PULL STATIONS

1. Pull stations shall contain circuits that communicate the station's status (alarm, normal or trouble) to the control panel over two wires, which also provide power to the pull station. The address shall be field programmable on the station.
2. Manual stations shall be double-action type, constructed of metal or of high impact, red Lexan with raised white lettering and a smooth high gloss finish.
3. Station shall mechanically latch upon operation and remain so until manually reset by means of a key common to all system locks. Stations that require Allen wrenches or special tools to reset them shall not be accepted.
4. Manual stations shall be fitted with screw terminals or wire leads for field wire attachment.

#### G. INTERFACE MODULES - GENERAL

1. If external power to Addressable Interface Modules is required, such power shall be 24VDC, and shall be derived from a supervised fire alarm power supply.
2. Addressable Interface Modules may be provided in either a Class B or Class A supervision version.
3. In the Class B version the wiring shall be supervised by an end-of-line device.
4. In the Class A version the wiring shall be looped back and connected to the module to allow continual operation of the controlled devices even if the wiring sustains a single break.
5. The interface modules shall be supervised and uniquely identified by the control panel. Device identification shall be transmitted to the control panel for processing according to the program instructions.

#### H. INTERFACE MODULES - SUPERVISED CONTROL

1. Supervised Control Modules shall be utilized where needed, for control of Notification Appliances.
2. For Notification Appliances, speakers, and other device control with Class B or Class A wiring supervision, the interface module shall provide a double-pole/double-throw relay output, with supervision.
3. These interface modules shall communicate the supervised wiring status (normal, trouble) to the fire alarm control panel and shall receive from the fire alarm control panel a command to transfer the relay.

#### I. INTERFACE MODULES - SUPERVISED MONITORING

1. Addressable Monitor Modules shall be suited for monitoring of water-flow, valve tamper, Fire Suppression Control Panels, and other non-intelligent detectors and systems.
2. Addressable Monitor Modules shall be provided in any needed configuration, and may be used to interface any of the following initiation devices to a Signaling Line Circuit, as follows:
  - a. Conventional 2-wire smoke detectors, including providing suitable power to the IDC.
  - b. Normally Open, dry contact type devices - with class B or class A wiring supervision:
    - 1) These interface modules shall communicate the Initiating Device Circuit status (normal, alarm, trouble) to the control panel.

#### J. INTERFACE MODULES - NON-SUPERVISED CONTROL

1. This interface module shall provide double-pole/double-throw relay switching for loads up to 120VAC. It shall contain easily replaceable 2 amp fuses, one on each common leg of the relay.

## **2.09 FAULT ISOLATOR MODULE (FIM)**

- A. The system shall employ Fault Isolator Modules (FIM) on the Signaling Line Circuits. These FIM units shall be utilized in order to isolate portions of SLCs, in the event of short circuit conditions. The SLC segment protected by each FIM shall be separated from the SLC in a manner such that a single short-circuit condition may not affect more than 25 Addressable Field Devices/Detectors, which are served by the isolated SLC segment.
- B. The FIM shall be located as close as practical to the point where the isolated SLC sub-circuit branches, and shall also be located at an accessible location.

## **2.10 CONVENTIONAL PERIPHERAL DEVICES**

### **A. SPRINKLER WATERFLOW SWITCHES**

- 1. Waterflow switches shall be individually monitored, via individual IDCs, Monitor Modules, or Mini Monitor Modules. The point corresponding to each Waterflow switch shall be programmed such that when activated, the suitable Fire Alarm sequence shall be initiated.
- 2. If the flow switch incorporates an internal "cover tamper switch", which actuates whenever the flow switch assembly cover is removed, the Trouble sequence shall be initiated in response to the removal of this cover.

### **B. SPRINKLER VALVE TAMPER SWITCHES**

- 1. Tamper switches shall be individually monitored by individual IDCs, Monitor Modules, or Mini Monitor Modules (Where two Valves, with Tamper Switches, are provided on both sides of a backflow preventer/double check valve assembly, such tamper switches may be monitored as a single point). The point corresponding to each Tamper Switch shall be programmed such that whenever the valve is partially closed, the Supervisory sequence shall be initiated.
- 2. If the tamper switch incorporates an internal "cover tamper switch", which actuates whenever the flow switch assembly cover is removed, the Trouble sequence shall be initiated in response to the removal of this cover.

## **2.11 AUDIO VISUAL NOTIFICATION APPLIANCES**

### **A. SPEAKERS**

- 1. Speakers shall have a metal or Lexan housing with field adjustable output taps ranging from 1/4 watt to 2 watts. Speakers selected for this project shall produce a Sound Pressure Level, at the 1 watt tap of at least 86 dBA at 10 feet – as tested per UL Standard 1480. Speakers shall have vandal resistant Lexan or metal grilles and shall be have sealed backs to protect the phenolic impregnated cone.

### **B. STROBES**

- 1. ALL strobes, and the strobe portion of audible/strobe combination units, shall be of the Xenon type.
- 2. All strobes shall be designed for synchronized flash operation at one flash per second (1 Hz) minimum over the device's listed input voltage range. Strobes shall be synchronized such that all strobe units within the building shall flash simultaneously (As a minimum, all devices on each floor shall flash simultaneously, with flash timing within the limits established by current UL standards.).

## **2.12 PRINTERS AND TERMINALS**

- A. A printer shall be provided adjacent to the fire alarm control panel as shown on the plans.

### **B. PRINTER**

- 1. A desktop 80-column, impact dot matrix printer shall provide a hard copy record of system events.
- 2. The printer shall receive English language text from the control panel in industry standard ASCII format via an EIA RS-232-C connection.
- 3. All printed information shall include time, date, status, point number, label, and the device type identifier.
- 4. The printer shall have the following features:
  - a. 120 VAC input power
  - b. 180 characters per second printing speed
  - c. 3 kilobytes buffer capacity
  - d. Cartridge type ribbon
  - e. Friction feed for cut forms
  - f. Tractor feed for continuous 9 1/2" wide pin-to-pin fanfold paper
  - g. UL 864 listed (UOXX)

5. Contractor shall supply one box of 2,300 (minimum) continuous-feed Sheets, 9 1/2" x 11", 20 Lb., Clean Edge, White Bond computer paper suitable for use the supplied printer.
- C. **TERMINAL**
1. A desktop terminal unit shall be provided. This terminal shall include a PC, LCD color monitor, keyboard and mouse. This terminal shall serve as an auxiliary annunciator, and as a convenient user interface for maintenance purposes.
  2. Contractor shall supply a dust-proof lockable cabinet with a see-through front cover to house the terminal and printer. Key shall be same as fire alarm control panel.

## **2.13 SPECIAL DEVICES**

### **A. TOOLS/KEYS**

1. Contractor shall provide two (2) keys per pull station. Keys shall be identical and usable in all keyways associated with this project – including, but not limited to Manual Pull Stations, the FACP, and FAAP.
2. Provide one device programmer tool and case for fire alarm systems utilizing hand-held or briefcase-style programming tools used to electronically assign addressees and/or programming parameters.

## **PART 3 – EXECUTION**

### **3.01 GENERAL**

- A. The complete installation shall be done in a neat, workmanlike manner in accordance with the applicable requirements of NFPA 70 - Article 760 and the manufacturer's recommendations.
- B. Smoke detectors shall not be mounted until the construction is completed, unless they are covered with plastic bags or fitted covers immediately after installation to maintain cleanliness.

### **3.02 RACEWAYS**

- A. All wiring shall be in a conduit system separate from other building wiring. See Section 26 05 33 – Raceway and Boxes for Electrical Systems for specifications.
- B. All wiring shall be in minimum 1/2" steel raceway. Factory colored red. Field painting of conduit is not permitted.
- C. 40% fill factor shall be applied to all conduit sizes.
- D. The contractor shall size conduit and boxes by circular mil size of each cable in each conduit or box. The circular mil sizing can be found on the manufacture's spec sheet, then use the NEC codebook to make calculation to follow NEC Chapter 9 Tables and Annex C for box and conduit fill.
- E. There shall be no sharp edges with installed materials.
- F. Use only identified conduit entries or request approval for other penetrations in cabinets; (certain areas require clear space for interior components/batteries). Cabinet shall be grounded to either a cold water pipe or grounding rod.

### **3.03 CONDUCTORS**

- A. All wire and cable associated with this system shall be as required by the equipment manufacturer. The following information is intended for estimating purposes only. However, the minimum wire gauges and colors specified shall be strictly adhered to. All cable shall be installed as per NEC Article 760.
- B. All initiation and notification circuit cabling shall be listed Type FPL (300V) in accordance with NEC article 760."
- C. All cables and wires #14 AWG and larger shall be stranded.
- D. Fire alarm wiring shall be held in place at the device box, by means of a two-screw connector, (do not use squeeze or crimp type connectors).
- E. All wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, disarrangement of any components, any open circuits or grounds in the system, an audible and visual trouble signal shall be activated until the system is restored to normal.
- F. All conductors shall be color-coded. Coding shall be consistent throughout the facility. Green wire shall be used only for equipment ground.

- G. Each Fire Alarm Control Panel and Annunciator Panel shall be connected to separate dedicated branch circuit from the building emergency panel, maximum 20 amperes. Circuit shall be labeled as "FIRE ALARM". The breaker shall be painted red and cap-locked.
- H. Power wiring for Fire Alarm Control Panel, Annunciator Panel shall be #12 AWG.
- I. Fire Alarm Control Panel and Annunciator Panel shall have #6 AWG green equipment ground wire.
- J. Fire alarm risers, notification appliance circuits and interconnections to remote panels (per NFPA 72) shall have a minimum 2Hr fire alarm rating. All notification appliance circuits shall be protected from the fire alarm panel of origination to the signaling zone they serve.
- K. Where fire alarm circuits enter or leave a building, additional transient 75 to 90 volt gas tube protection shall be provided for each conductor.
- L. Leave 8-inch wire tails at each device box and 36-inch wire tails at the Fire Alarm Control Panel and Remote Annunciator Panels.
- M. Cable for Intelligent detector Loops shall be 18 to 12 AWG twisted pair with a shield jacket or per manufacturers recommendations installed in ½" conduit. Shield continuity must be maintained and connected to earth ground only at the control panel.
- N. SLC wiring must not be in the same conduit with AC power wiring or other high current circuits. T-taps or branch circuit connections are allowed for all class B SLCs.
- O. Cable for RS 232-c devices (CRT, PRINTER) shall be dual pair twisted- shielded.
- P. All splices or connections shall be made within approved junction boxes and with approved fittings. Boxes shall be red and labeled "FIRE ALARM SYSTEM" or "FA" by decal or other approved markings.
- Q. Speaker and strobe circuits shall have separate conductors, and shall operate independently of each other.
- R. Speaker wiring shall be #18 AWG twisted-shielded cable or per manufacturers recommendations.
- S. Strobe wiring shall be #14 AWG minimum.
- T. Tray cable is not acceptable for use as fire alarm system wiring installed in conduit.

### **3.04 DEVICE MOUNTING**

- A. Unless otherwise noted on the drawings, plans, specifications or by the Architect or Engineer; the recommended mounting heights, and requirements are as follows:
  - B. Fire Alarm Control Panels
    - 1. Mount control panels such that all visual indicators and controls are located at 60 inches above floor level.
  - C. Annunciator/Remote Fire Command Center Panels
    - 1. Mount FAAP/RFCC panels such that all visual indicators and controls are located at 60 inches above floor level.
  - D. Visual and Audio/Visual Notification Appliances
    - 1. In Public-Mode Areas, as defined within NFPA-72, install flush, semi-flush or surface between 80 inches and 96 inches or 6 inches below finished ceiling or at 80 inches from the bottom of the device to the highest level of the finished floor. No devices protruding 4 inches or more shall be installed lower than 80 inches. If these requirements are not achievable, consult with the Engineer before installation.
    - 2. Audio/visual devices may be installed on the ceilings only where indicated, or where approved in writing by the Engineer. (In such cases, these devices shall be installed in accordance with current NFPA 72 standards).
    - 3. Except as noted in the previous paragraph, all audio/visual devices shall be installed at the same height throughout the facility.
    - 4. For surface mounting, use manufacture-supplied back boxes and trim plates, which shall be painted Red or off White, and shall contain no visible conduit knock-outs. Mark each device with its circuit number.
  - E. Manual Stations
    - 1. The operable part of the manual stations shall be installed not less than 3 ½ ft. (42") and not more than 4 ft. (48") above finished floor. All Manual Stations shall be in unobstructed locations. Mark the unit's address on the inside and outside of housing.
    - 2. All manual pull stations shall be installed at the same height throughout the facility.
    - 3. For surface mounting, use manufacture-supplied back boxes and trim plates. Back boxes shall be painted Red or off White, and shall contain no visible conduit knock-outs. Mark each device with its loop and address.



4. During the installation of the new fire alarm systems, new pull stations should be covered or identified as not being operable so building occupants will not be confused as to which fire alarm pull station should be pulled during an alarm condition. Likewise, after the new system is installed, tested and accepted, the existing pull stations should be identified as not being operable (or permanently removed as soon as possible).
- F. Smoke Detectors
1. The location of detector shown on the plans is schematic only. The detector must be located according to code requirements.
  2. Surface mounted detector shall be installed using back boxes equal to the base's size. Standard octagon and square boxes are not acceptable.
  3. Detector should be located on the highest part of a smooth ceiling so that the edge of the detector is no closer than 4 inches from a sidewall. Ceilings with beams, joists or soffits that exceed 8 inches in depth require special planning and closer spacing.
  4. If it is necessary to mount a detector upon a sidewall, the top of the detector (the sensing chamber portion of the device) shall be located no closer than 4 inches from the ceiling and no further away than 12 inches.
  5. Smoke detector should be installed to favor the air flow towards return openings and not located closer than 3 feet from air supply diffusers which could dilute smoke before it reaches the detector. No detectors shall be installed in direct airflow.
  6. Smoke detectors/Sensors – both Intelligent and non-addressable, shall be installed in accordance with their UL Listed Spacing.

### **3.05 IDENTIFICATION**

- A. Attach the label containing the address and SLC designation to:
  1. Each addressable detector. Label shall be visible and readable from the floor, 3/16" minimum character size (1/4" is recommended).
  2. Each manual pull station. Label shall be placed on the top part
  3. Each Addressable Module. Label shall be attached to the faceplate
  4. Each speaker/strobe, speaker only or strobe only shall be labeled with device circuit and amp circuit.
- B. Label shall consist of black writing on white or clear background.
- C. All junction boxes shall be painted red and labeled "Fire Alarm" or "FA".
- D. All circuits must be labeled with the name of circuit and the area being served by the circuit.
- E. Wire/cable splices in junction boxes shall be labeled indicating where the wire/cable is coming from and where it is going.
- F. All conductors terminated in control panels, annunciator panels and extension panels shall be labeled.
- G. All audio visual devices shall be labeled by each circuit and the order of the device on that circuit such as "Circuit No. 2, strobe No. 05 of 10".
- H. All labels shall be permanent, and be machine generated. **NO HANDWRITTEN OR NON-PERMANENT LABELS SHALL BE ALLOWED.** Submit a sample for approval before using any labeling schemes.
- I. Label size shall be appropriate for the conductor or cable size(s) and design. All labels to be used shall be self-laminating, white/transparent vinyl and be wrapped around the cable (sheath). Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminate over the full extent of the printed area of the label.
- J. Adhesive type labels not permitted except for phase and wire identification.

### **3.06 TESTING**

- A. Before proceeding with any testing, all persons, facilities and building occupants whom receive alarms or trouble signals shall be notified by the contractor to prevent unnecessary response or building occupant distress. At the conclusion of testing, those previously notified shall be notified that testing has been concluded.
- B. The manufacturer's authorized representative shall provide on-site supervision of installation of the complete fire alarm system installation, perform a complete functional test of the system, and submit a written report to the Contractor attesting to the proper operation of the completed system prior to final inspection.

- C. Contractor shall pre-test each and every device in the system before the system is considered ready for final inspection.
- D. The completed and pre-tested fire alarm system shall be fully tested in accordance with NFPA-72 by the Contractor in the presence of the Engineer, Owner's representative and the local Fire Marshal.
- E. The Engineer or his authorized representative may suspend or discontinue the tests at any time performance is considered unsatisfactory. Resumption of testing will cover untested elements and any replaced elements. The contractor shall furnish all test personnel, test instruments and equipment of the accuracy necessary to perform the test. Arrangements for testing must be made with the Owner and the Engineer at least two weeks before the proposed testing date.
- F. Upon the completion of a successful test, and prior to the final request for payment the Contractor shall:
  - 1. Certify the system to the Owner in writing
  - 2. Complete the NFPA 72 record of completion form
  - 3. Provide as builts and O&M manuals.
  - 4. Provide a signed statement that the Owner had received the specified system operation and maintenance training
- G. The final payment will not be processed unless these documents are complete and are on hand.

### **3.07 WARRANTY**

- A. The Contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of two (2) years from the date of substantial completion of the project.
- B. At the end of the project, the Contractor shall post the warranty period along with the company's name and telephone number inside the fire alarm panel.
- C. Any occupied facility shall not be without a UL and an NFPA approved and fully operational fire alarm system for a period longer than two (2) hours. Emergency response shall be provided within two (2) hours of the notification, to the contractor, of the failure of the system to perform operationally per UL and NFPA standards. Non-emergency service calls shall be responded to within twenty-four (24) hours of the notification to the contractor.
- D. Emergency situations may include, but not limited to
  - 1. System can't be acknowledged or reset
  - 2. System is non-responsive to commands
  - 3. System in non-responsive to actuated alarm devices
  - 4. Malfunction of notification/initiating circuit(s)
  - 5. System going into alarm/trouble without indicating the source
  - 6. System is dead (no power), etc.
- E. Repairs and/or replacement arising from emergency situations shall be completed within twenty-four (24) hours of the time of notification. Other than emergency, actual repairs and /or replacement shall be provided within seventy two (72) hours of the time of notification during normal working hours, Monday through Friday, excluding holidays. If the repairs involve parts that are not shelve items and require lead time, the contractor shall inform the Owner within twenty-four (24) hours from the time of notification of the exact time when the repairs will be completed.
- F. If repair and/or replacement cannot be made within the prescribed time, then other means and methods of protection shall be provided to insure the safety of the building's occupants during which time the system is not in compliance with the standards. This may involve up to and include hiring Owner approved qualified personnel to stand a fire watch, all at the contractor's expense.
- G. Warranty service for the equipment shall be provided by the system supplier's factory trained representative. Further, Warranty shall include all parts, labor and necessary travel.

### **3.08 SPECIAL CONSIDERATIONS**

- A. Contractor shall refer to Division 1, General Requirements, "SPECIAL SITE CONDITIONS".

### **3.09 TRAINING**

- A. The Contractor through his/her supplier shall provide, as part of this contract, a minimum of 4 hours system operation training for owner, the Architect/Engineer, and fire department personnel. The training session shall consist of the following sessions:

1. Two 1-hour sessions for the purpose of training personnel who will need to operate the system – primarily, Level 1 and Level 2 system operators/users.
  2. A single 2-hour session for the purpose of training personnel who will need to administrate and maintain the system. This training session shall familiarize these “power-users” with High-Level functions, and shall also familiarize Electrical Department personnel with an overview of the as-built drawings and equipment configuration/basic troubleshooting.
- B. All training sessions shall be coordinated and scheduled by the EC, and shall be conducted at a time to be stipulated by the owner. All training and other indoctrination shall be completed prior to final inspection.
  - C. The contractor shall record all training and instructional sessions on DVD. Provide a separate DVD for each system and label for the system demonstrated and turnover to the Owner.
  - D. Training shall not take place until all systems are 100% operational as determined by the Owner. The purpose of training is to fully prepare the facility maintenance staff for complete operational responsibility of the fire alarm system.
  - E. The facility maintenance staff shall be fully trained and be given the capability by the product Vendor and installing Contractor to modify, to program, to fully repair, to service, and to maintain the system after (and if desired, during) the warranty period.
  - F. The above training shall include, but not be limited to, providing and reviewing all programming software, access codes, and licenses that allow the Owner to add or to delete any points (i.e.: The mapping of devices), and to change a heat detector to a smoke detector. To meet this requirement, provide the necessary configuration and/or access code (hardware and/or software key). If the Vendor cannot meet this requirement, the product is not acceptable.

END OF SECTION

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## **SECTION 31 20 00 EARTHWORK**

### **PART 1 - GENERAL**

#### **1.1 RELATED WORK**

- A. Provisions of Division 01 shall govern work under this Section.

#### **1.2 SUMMARY**

- B. This Section includes:
  - 1. Preparing sub grades for slabs-on-grade, walks, pavements, lawns and grasses and exterior plants.
  - 2. Excavating and backfilling for buildings and structures.
- C. Related Sections:
  - 1. Division 02 Section "Site Clearing" for protection of existing trees indicated to remain, site clearing and grubbing, stripping and stockpiling topsoil, and removal of above-grade and below-grade improvements.
  - 2. Division 02 Section "Erosion Control" for temporary erosion and sedimentation control measures.
  - 3. Division 02 Section "Sub-drainage" for drainage of foundations, slabs-on-grade and walls.

#### **1.3 DEFINITIONS**

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
- B. Base Course: Course placed between sub-base course and hot-mix asphalt paving.
- C. Bedding Course: Course placed over excavated sub-grade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Choker Course: Course supporting slab-on-grade placed immediately below vapor retarder.
- F. Drainage Course: Drainage fill supporting slab-on-grade that also minimizes upward capillary flow of pore water.
- G. Excavation: Removal of material encountered above sub-grade elevations and to lines and dimensions indicated.
- H. Unauthorized Excavation: Excavation below sub-grade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- I. Fill: Soil materials used to raise existing grades.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

- K. Sub-base Course: Course placed between sub-grade and base course for hot-mix asphalt pavement, or course placed between sub-grade and cement concrete pavement or cement concrete or hot-mix asphalt walk.
- L. Sub-grade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below sub-base, drainage fill, or topsoil materials.
- M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

#### **1.4 SUBMITTALS**

- A. Product Data: For controlled low-strength material, including design mixture.
- B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
- C. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.

#### **1.5 QUALITY ASSURANCE**

- A. Geotechnical Testing Agency Qualifications: Testing agency qualified according to ASTM E 329 to conduct soil materials testing, as documented according to ASTM D 3740 and ASTM E 548.
- B. Pre-excavation Conference: Conduct conference at Project Site to comply with requirements in Division 01 Section "Project Management and Coordination."

#### **1.6 PROJECT CONDITIONS**

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated in these Specifications.
- B. Notify Architect not less than 2 days in advance of proposed utility interruptions.
- C. Do not proceed with utility interruptions without Architect's written permission.
- D. Contact utility-locator service for area where Project is located before excavating.

### **PART 2 - PRODUCTS**

#### **2.1 SOIL MATERIALS**

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, or a combination of these groups; free of rock or gravel larger than 3 inches in dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
  - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

- D. Sub-base Material: Approved naturally or artificially graded mixture of natural or crushed gravel, crushed stone and natural or crushed sand; Subsection 212.2 of the State of Wisconsin Department of Transportation Standard Specifications for Highway and Structure Construction, 1996 Edition; or engineered fill.
- E. 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 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- F. Bedding Course: Naturally or artificially graded 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.
- G. Drainage Fill: Narrowly graded mixture of washed 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 0 to 5 percent passing a No. 8 sieve.

## **2.2 CONTROLLED LOW-STRENGTH MATERIAL**

- A. Low-density, self-compacting, flowable concrete material as follows:
  1. Portland Cement: ASTM C 150, Type I II or III.
  2. Fly Ash: ASTM C 618, Class C or F.
  3. Normal-Weight Aggregate: ASTM C 33, 3/8-inch nominal maximum aggregate size.
  4. Water: ASTM C 94/C 94M.
  5. Air-Entraining Admixture: ASTM C 260.
- B. Compressive Strength: 500-psi when tested according to ASTM C 495.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect and maintain erosion and sedimentation controls during earthwork operations.
- C. Provide protective insulating materials to protect sub-grades and foundation soils against freezing temperatures or frost.

### **3.2 DEWATERING**

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared sub-grades, and from flooding Project Site and surrounding area.
- B. Protect sub-grades from softening, undermining, washout, and damage by rain or water accumulation.
  1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

### **3.3 EXCAVATION, GENERAL**

- A. Excavate to sub-grade elevations regardless of the character of surface and subsurface conditions encountered. Excavated materials may include rock, soil materials, and obstructions. No changes in Contract Sum or Contract Time will be authorized for rock excavation or removal of obstructions.
  - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
- B. Explosives: Do not use explosives.

### **3.4 EXCAVATION FOR STRUCTURES**

- A. Excavation beneath structure is intended to remove existing loose/soft soils or fill. If soils extend below indicated subgrade elevations, over-excavation will be required.
- B. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

### **3.5 SUBGRADE INSPECTION**

- A. Notify Geotechnical Engineer when excavations have reached required subgrade.
- B. If Geotechnical Engineer determines unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed. Replacement of over excavated soils will be as indicated in Specifications.
- C. Proof-roll sub-grade below building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated sub-grades.
  - 1. Completely proof-roll sub-grade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
  - 2. Proof-roll with a loaded 10-wheel tandem-axle dump-truck weighing not less than 15 tons.
  - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed by the Geotechnical Engineer.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct sub-grades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

### **3.6 UNAUTHORIZED EXCAVATION**

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Controlled low strength material with 28-day compressive strength of 500 psi may be used when approved by Architect.
  - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.



### **3.7 STORAGE OF SOIL MATERIALS**

- A. Stockpile borrow-soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### **3.8 FILL, GENERAL**

- A. Place fill, including back-fill, sub-base and drainage courses, on sub-grades free of mud, frost, snow, or ice.

### **3.9 BACKFILL**

- A. Place and compact backfill in excavations promptly, but not before completing the following:
  - 1. Construction below finish grade including, where applicable, sub-drainage, damp proofing, waterproofing, and perimeter insulation.
  - 2. Surveying locations of underground utilities for Record Documents.
  - 3. Testing and inspecting 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.

### **3.10 SOIL FILL**

- A. Place and compact initial backfill of engineered fill, free of particles larger than 1 inch in any dimension, or controlled low-strength material, to a height of 12 inches over utility pipe or conduit.
  - 1. Carefully compact initial engineered fill backfill under pipe haunches and compact evenly up on both sides and along full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- B. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- C. Place and compact final backfill of satisfactory soil to final sub-grade elevation.
- D. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- E. Place and compact fill material in layers to required elevations as follows:
  - 1. Under grass and planted areas, use satisfactory soil material.
  - 2. Under walks and pavements, use sub-base material.
  - 3. Under steps and ramps, use engineered fill.
  - 4. Under building slabs, use engineered fill beneath drainage fill and choker course
  - 5. Under footings and foundations, use engineered fill.

### **3.11 SOIL MOISTURE CONTROL**

- A. Uniformly moisten or aerate sub-grade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  - 1. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### 3.12 COMPACTION OF BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
  - 1. Under structures, building slabs, steps, and pavements, scarify and re-compact top 12 inches of existing sub-grade and each layer of backfill or fill soil material at 95 percent.
  - 2. Under walkways, scarify and re-compact top 6 inches below sub-grade and compact each layer of backfill or fill soil material at 92 percent.
  - 3. Under lawn or unpaved areas, scarify and re-compact top 6 inches below sub-grade and compact each layer of backfill or fill soil material at 85 percent.
  - 4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

### 3.13 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  - 1. Provide a smooth transition between adjacent existing grades and new grades.
  - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish sub-grades to required elevations within the following tolerances:
  - 1. Lawn or Unpaved Areas: Plus or minus 1 inch.
  - 2. Walks: Plus or minus 1 inch.
  - 3. Pavements: Plus or minus 1/2 inch.
- C. Grading Inside Building Lines: Finish sub-grade to a tolerance of 1/2-inch when tested with a 10-foot straightedge and 3/4-inch over entire excavation.

### 3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality control testing.
  - 1. Allow testing agency to inspect and test sub-grades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work show compliance with requirements.
- B. Footing Sub-grade: At footing sub-grades, at least one test of each soil stratum will be performed to verify design bearing-capacities. Subsequent verification and approval of other footing sub-grades may be based on a visual comparison of sub-grade with tested sub-grade when approved by Architect.
- C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At sub-grade and at each compacted fill and backfill layer, at least 1 test for every 2500 square foot or less of paved area or building slab, but in no case fewer than 3 tests.
  2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.
  3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.
- D. When testing agency reports that sub-grades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; re-compact and retest until specified compaction is obtained.

### **3.15 PROTECTION**

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to tolerances specified to where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- C. Where settling occurs before project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
  1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### **3.16 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

**END OF SECTION**



## **ARTICLE 402 - ASPHALT CONSTRUCTION**

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### **402.1 Materials for Asphalt Construction.**

The materials intended for use in base, lower, and upper layer mixtures, tack and seal coats, surface treatments, and similar work, shall comply with the requirements of Part 4, "Pavements" of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation, except as modified herein or in the Special Provisions of the contract.

Wherever the terms "Division", "Divisions", "Department" or "Departments" appear in the above mentioned specifications, such terms shall be understood to mean "City" or "City's" respectively.

Aggregate shall be from a Wisconsin Department of Transportation approved source as specified under 106.3.4.2 except the Contractor shall provide to the City the results from the Freeze / Thaw Test (AASHTO T103) for quarried course aggregates used in the work produced from limestone/dolomite sources. The maximum percent loss for aggregates used in the work shall be four percent (4%).

The Contractor shall provide Asphalt Pavement mix designs in accordance with the aforementioned Part 4 of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation. The Engineer reserves the right to designate a grade of asphalt at the time of construction other than that specified in the contract.

### **402.2 Placing Asphalt Mixtures.**

#### **402.2(a) Description.**

Asphalt mixtures shall not be placed when the air temperature approximately three (3) feet above ground at the site of the work, in the shade and away from the effects of artificial heat, is less than 40°F unless approved by the Engineer in writing. Notify the engineer at least one business day before paving.

The contractor shall submit a cold weather paving plan outlining equipment changes, including modifications to the compaction process and when to use them, when the air temperature is less than 40°F, approximately 3 feet above grade, in the shade and away from the effects of artificial heat. Engineer written acceptance is required for the cold weather paving plan. Engineer acceptance of the plan does not relieve the contractor of responsibility for the quality of HMA pavement placed in cold weather.

The fact that the Engineer does not grant such approval shall not be construed as substantiating an extension of contract time for the completion of the work. Whenever such approval to extend the paving season has been denied, the Contractor shall ramp all access structures, catchbasins and water valve castings, ends of pavements, and curb edges with asphalt material to facilitate maintenance of the pavement area during the suspension of paving operations. Prior to the installation of succeeding layers of asphalt pavement, all such ramping shall be removed as directed by the Engineer and disposed of by the Contractor. All costs of installing and removing such ramping shall be at the Contractor's expense.

## Part IV - Pavements

Place asphaltic mixture only on a prepared, firm, and compacted base, foundation layer, or existing pavement substantially surface-dry and free of loose and foreign material. Do not place over frozen subgrade or base, or where the roadbed is unstable.

After all layers have been thoroughly compacted, they may be tested for smoothness by means of a fourteen (14) foot straightedge placed parallel to the center line of the pavement, parallel to the grade line in each lane, and touching the surface. Ordinates measured from the face of the straightedge to the lower layer shall at no place exceed one-fourth (1/4) inch. Variations exceeding one-fourth (1/4) inch in the lower layer shall be corrected as directed by the Engineer. Ordinates measured from the face of the straightedge to the upper layer shall not exceed one-eighth (1/8) inch. For each variation in the upper layer greater than one-eighth (1/8) inch but less than one-fourth (1/4) inch, where directed by the Engineer, the area affected shall be removed and replaced with fresh upper layer mixture at the expense of the Contractor. If variations in the upper layer exceed one-fourth (1/4) inch, the entire area affected shall be removed and replaced with fresh upper layer mixture at the expense of the Contractor.

The Contractor shall be responsible for and maintain the work during the several stages of construction and until the acceptance thereof. Such maintenance shall include protection and repair of the foundation, tack coat, base, and surface. Any rich or bleeding areas, any breaks, any raveled spots, or other unsatisfactory areas shall be corrected during such maintenance period.

The Contractor shall protect all sections of the newly placed and compacted mixture from traffic until the material has cooled and hardened to the satisfaction of the Engineer. The Contractor shall furnish, install and maintain barricades to protect the surfaces tack coated and the pavement laid from traffic. Barricades may be removed only with the Engineer's approval. Barricades and fencing shall be designed and installed so as not to mark or otherwise damage the completed pavement.

Paving equipment shall not be cleaned with kerosene, fuel oil or gasoline on newly laid asphalt pavement, crushed stone base course prepared for asphalt pavement, or on existing asphalt pavements, unless the pavement or base is protected with a material, acceptable to the Engineer, which shall prevent cleaning oils or fluids from coming in contact with the pavement or base.

The Contractor shall maintain on the project suitable fire fighting equipment, or other equipment of similar purpose, and an adequate supply of hand brooms, shovels, mechanical tampers, hand tampers, lutes, and iron rake for use at places which are inaccessible to pavers and rollers. The Contractor shall not commence paving on each day unless the above equipment is on the paver or readily available for use. A steel plate will also be required and utilized when paving over open grates and inlets.

Prior to beginning the installation of the asphalt upper layer on any project, the Contractor shall complete the final adjustment of all water valve castings to finished grade.

The Contractor shall thoroughly clean all hard surfaces immediately before applying tack material to areas overlaid with HMA mixtures. Such cleaning to remove all dust, debris, or other objectionable material shall be done using a street sweeper with vacuum or regenerative pickup head or equal. Unsatisfactory areas shall be hand cleaned by sweeping or compressed air as directed by the Engineer.

402.2(b) Personnel.

The Contractor shall provide competent workers who are capable of performing the duties assigned to them in the work of placing and compacting asphalt mixtures in accordance with the specifications. The paving crew shall be under the supervision of an experienced supervisor who shall be on the project at all times, and who shall not operate equipment, such as paving machines or rollers, at any time during the paving operation. Under no circumstances shall the workers, or others, be allowed to walk across recently laid asphalt mixture behind the paving machine and ahead of the roller.

402.2(c) Equipment.

A mechanical vibratory plate compactor shall be available on the job site at all times during asphalt pavement placement and shall be used for compaction around access structures, catchbasins, water valves and other castings which appear in the paved areas. The mechanical vibratory plate compactor shall be equipped with a working water reservoir and shall be of sufficient size and capability to attain the compaction requirements of these specifications.

402.2(d) Spreading and Finishing.

Pave at a constant speed, according to the paver specifications and mixture, for uniform spreading and strike-off with a smooth, dense texture and no tearing or segregation.

In any event, the speed of placing asphalt mixtures shall not exceed that which coincides with the average rate of delivery to the paver, so as to provide as nearly as possible continuous operation of the paver.

The roller shall pass over an unprotected end of freshly laid mixture only when the laying of the course is to be discontinued long enough to permit the mixture to become cooled. In the event of such discontinuance, the end of the course shall be treated as a transverse construction joint as specified below.

402.2(e) Compaction.

Where the edges are not supported by a curb and gutter or similar structure, the outside edges of the lower and upper layers shall be sloped and pressed in place by means of a self adjusting constant pressure edge plate held in proper position on the finishing machine. A string line shall be used as a guide for the finishing machine in order to maintain a uniform edge alignment. If any other method is used, it shall meet the approval of the Engineer. The edge of the pavement shall be sloped approximately one (1) inch from the vertical and no material shall extend beyond the limits of the base. Irregularities in alignment along the outside edges and along the longitudinal joints shall be corrected by adding or removing paving mixtures before the edges are rolled.

The mixture shall be spread sufficiently so that after compaction the finished surface shall be one-eighth (1/8) to one-fourth (1/4) inch above the edges of curbs, gutters, access structures and similar structures.

Each roller, while the paving is under way, shall be kept as nearly as practicable in continuous operation and the speed shall at all times be slow enough to avoid undue displacement of the mixture. When pneumatic-tired rollers are used, they shall be operated continuously at a rate of speed which

will not cause damage to the mat and which will provide the maximum number of coverages possible while the temperature of the mat is conducive to densification and surface sealing. Rollers shall be operated with the drive roll or wheels nearest the paver.

<b>MINIMUM REQUIRED DENSITY*</b>		
<b>Layer</b>	<b>Percent of Target Maximum Density</b>	
	<b>Mixture Type</b>	
	<b>E-0.3, E-1, E-3</b>	<b>E-10</b>
Lower	92.0	92.0
Upper	92.0	92.0

**402.2(f) Joints.**

Longitudinal joints including mainline interior joints for all pavement layers shall be “hot” joints. “Hot” joints shall be defined as joints with a temperature at or above the asphalt mixture compaction temperature.

Evenly reheat at least an 8-inch wide strip of the previously compacted surface lift in the adjacent lane as follows:

- Ambient air temperature above 60° F, reheat to 130° F.
- Ambient air temperature below 60° F, reheat to 120° F.

The engineer may modify the required joint reheat temperatures to adjust for weather, wind, or other field conditions. Coordinate the heater output and paver speed to achieve the required joint reheat temperature without visible smoke emission.

Contractor shall provide a self-contained heating unit that heats by convection only. Do not use forced air to enhance the flame. Provide a fireproof barrier between the flame and the heater's fuel source. The heater must produce a uniform distribution of heat within the heat box. Provide automatic controls to regulate the heater output and shutoff the heater when the paver stops or the heater control system loses power. Mount the heater on the paver inside the paver’ automatic leveling device.

Where “Michigan” joints are placed to allow traffic use, the joint shall be milled, reheated and tacked in accordance with the above stated reheating specification before continuation of paving.

Contractor’s operations shall not result in additional transverse joints unless approved by the Engineer.

**402.3 Asphalt Pavement.**

Unless otherwise specified or directed by the Engineer, asphalt driveways and asphalt terrace paving shall be constructed of three (3) inches of upper layer pavement installed in one (1) lift on select fill, or as directed by the Engineer. 4 LT 58-28 S, 5 LT 58-28 S mixture or an approved commercial mix shall be used, unless a substitute is approved by engineer.

The composition for the various asphalt mixtures shall conform to the limits specified in Part 4 of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation, except as modified herein or in the Special Provisions of the contract. Warm mix HMA is not approved.



Part IV - Pavements

The mixture shall be laid and compacted so that the average yields in pounds per square yard shall conform to the following charts showing the various thicknesses of installation:

Unless otherwise specified in the contract, or directed by the Engineer, the upper layer mixtures shall be installed in one course of one and one-half (1-3/4) inches in depth.

<b>UPPER &amp; LOWER LAYER(S) YIELD - #/S.Y.</b>		
<b>Thickness</b>	<b>Min.</b>	<b>Max.</b>
1.5"	172	180
1.75"	201	210
2"	230	240
2.5"	287	300
3"	345	360
4"	460	480
5"	575	600

For installations of the upper layer which are specified to be other than one and one-half (1-1/2) inches in depth, the allowable yields for such installations shall be in proportion to the allowable yields specified above.

Whenever the yields fall below the minimum allowable yields specified above, the Engineer shall determine the corrective action to be taken. The corrective action may include removal and replacement of the area of deficient thickness, an overlay with approved material of the area of deficient thickness, or such other action as the Engineer shall determine including a reduction in payment up to 50% of the unit price for the deficient amount. The area of deficient thickness shall be determined on the basis of street area, project area, or area covered in one day's operation, whichever is less. The Engineer's determination will be based on the circumstances of the area involved, and will include a determination of the distribution of costs of the corrective work required.

Recycled Asphaltic Materials

The contractor may use recycled asphaltic materials from FRAP, RAP, and RAS in HMA mixtures. Stockpile recycled materials separately from virgin materials and list each as individual JMF components.

Control recycled materials used in HMA by evaluating the percent binder replacement, the ratio of recovered binder to the total binder. Conform to the following:

<b>MAXIMUM ALLOWABLE PERCENT BINDER REPLACEMENT</b>		
<b>Recycled Asphaltic Material</b>	<b>Lower Layers</b>	<b>Upper Layer</b>
RAS if used alone	25	20
RAP and FRAP in any combination	40	25
RAS, RAP and FRAP in combination*	35	25

\*When used in combination the RAS component cannot exceed 5 percent of the total weight of the aggregate blend.

#### **402.4 Asphalt Tack Coat.**

Unless otherwise specified in the contract, or directed by the Engineer, the types and grades of asphalt materials and rates of applications in gallons per square yard shall conform to the following requirements:

1. The tack coat material shall be type MS-2, SS-1, SS-1h, CSS-1, or an approved modified emulsified asphalt.
2. For existing concrete or asphalt pavements, the rate of application shall be between 0.07 and 0.10 gallons per square yard.
3. Diluting emulsified asphalt only if approved by the engineer. Provide calculations using the asphalt content as received from the supplier and subsequent contractor dilutions to show that as-placed material has 50 percent or more residual asphalt content.

The Contractor shall apply asphaltic tack coat to streets prior to placing asphalt pavement as directed by the Engineer. No tack coat shall be placed on the base course unless directed by the Engineer. The Contractor shall apply an asphaltic tack coat to all butt joints and all longitudinal joints meeting both existing pavements and new pavements on successive paving passes. All costs for furnishing and applying tack coat to butt joints and longitudinal joints as specified above shall be considered incidental to the bid item for asphalt tack coat.

Apply tack coat only when the air temperature is 32°F or more unless the engineer approves otherwise in writing. Before applying tack coat ensure that the surface is dry and reasonably free of loose dirt, dust, or other foreign matter. Do not apply if weather or surface conditions are unfavorable or before impending rains.

#### **402.5 Recycled Asphalt Pavement.**

This work shall consist of the construction of a plant mixed recycled asphalt mixture furnished and placed all in accordance with Article 460 of the latest edition of the Standard Specifications for Highway and Structure Construction of the State of Wisconsin, Department of Transportation, except as listed below.

The City of Madison shall approve the sources of recycled asphalt material, including shingles.

#### **402.6 Measurement and Payment.**

##### **402.6(a) Asphalt Pavement Mixtures.**

Asphalt mixtures of the type or types included in the contract, shall be measured by the ton of mixed aggregate and asphalt material, or by the square yard of area paved. The quantity measured for payment shall be the amount of material furnished, delivered to and incorporated in the accepted work, or the area paved, including cleaning and maintenance, and for all labor, tools, equipment, and incidentals necessary to complete the work contemplated by the contract. Deductions shall be made for any quantities which are wasted, which are not actually incorporated in the work in accordance with the contract, and for those materials which do not conform to the requirements of these specifications.

Part IV - Pavements

Asphalt mixtures shall be tested by the City in order to determine aggregate gradations, asphalt content, air voids and VMA.

When the average yield on a project exceeds the maximum allowable yield, as specified in Section 402.3, all excess material shall be paid for at the rate of one-half (1/2) the contract unit price for the type of material involved. The average yield for this purpose shall be computed on a daily basis, a project basis, or a street area, whichever covers the smallest area of paving.

When the average yield on a project is below the minimum yield allowable, as specified in Section 402.3, the quantity of material below the minimum shall be paid at a rate no less than one-half (1/2) the contract unit price for the type of material involved if required by the Engineer. The average yield for this purpose shall be computed on a daily basis, a project basis, or a street area, whichever covers the smallest area of paving.

If the average density for the day on a project is less than the specified minimum in section 402.2(e), pay will be reduced based on the contract unit price for the HMA Pavement bid item as follows:

<b>DISINCENTIVE PAY REDUCTION FOR HMA PAVEMENT DENSITY</b>	
<b>Percent Density Below Specified Minimum</b>	<b>Payment Factor (percent of contract price)</b>
From 0.5 to 1.0 inclusive	98
From 1.1 to 1.5 inclusive	95
From 1.6 to 2.0 inclusive	91
More than 2.0	(1)

(1) Remove and replace with a mixture at the specified density. When acceptably replaced, payment will be made for the replaced work at the contract unit price. Alternatively the engineer may allow the nonconforming material to remain in place with a 50 percent payment factor.

The Contractor shall furnish and deliver to the Engineer a ticket with each load showing the project name, date, time, ticket number, truck number, material type and mix number, load count, gross, tare, net weights, cumulative weight, of hot mix asphalt. All tickets for materials delivered to a City of Madison project shall be presented to the City representative on the project within twenty-four (24) hours after delivery of the materials to the project. Tickets presented after the time specified shall be rejected due to inability to substantiate actual use of the materials on the project.

As an alternative to furnishing individual load tickets, the contractor may submit a daily summary sheet of hot mix asphalt delivered to the project. This sheet shall include project name, date, time, ticket number, truck number, material type and mix number, load count, gross, tare, net weights, cumulative weight for each load delivered to the site and a daily summary of total weight provided for each item. This summary sheet shall be provided to the inspector within twenty-four (24) hours after delivery of the material to the project. The actual tickets shall be made available upon request.

**402.6(b) Asphalt Tack Coat.**

The asphalt materials required for and incorporated in the work of applying asphalt tack coat shall be measured by volume in gallons as provided in the contract. Deductions shall be made for any quantities which are wasted or are not actually incorporated in the work in accordance with the contract.



11. PAVEMENT MARKINGS SHALL BE IN ACCORDANCE WITH SECTION 646 OF THE STANDARD SPECIFICATIONS OR PER CITY OF MADISON REQUIREMENTS THE MORE STRINGENT OF THE TWO SHALL APPLY.

**ARTIFICIAL TURF**

1. CONTRACTOR SHALL HIRE AND RELY ON A QUALIFIED ARTIFICIAL TURF SYSTEM INSTALLER (PREFERABLY THE ORIGINAL INSTALLER— SEE NOTE 2) FOR ANY REMOVAL, REGRADING, DRAIN TILE RECONFIGURATION, AND RESTORATION OF AFFECTED AREAS OF ARTIFICIAL TURF AND ASSOCIATED UNDER DRAIN SYSTEM. DESIGN SHOWN ON THESE PLANS IS CONSIDERED MINIMUM REQUIRED WORK — THERE MAY BE A NEED TO REMOVE, REINSTALL DRAIN TILE, OR REGRADE ADDITIONAL PORTIONS OF THE ARTIFICIAL TURF SYSTEM SO AS NOT TO COMPROMISE THE PERFORMANCE OF THE SYSTEM. THE COST OF THIS ADDITIONAL WORK IS CONSIDERED INCIDENTAL, AND SHALL BE INCLUDED IN THE BID PRICES. SPECIAL CONSTRUCTION EQUIPMENT OR CONTROL MEASURES MAY BE REQUIRED FOR WORK NEAR THE EXISTING SYSTEM.

2. The artificial turf system was provided by FieldTurf USA, Inc. 2559 Washington Rd Ste 530, Pittsburgh, PA 15241, phone (412) 835-7060. The installation contractor shall have completed a minimum of 5 artificial fields to demonstrate sufficient experience. The original installation contractor was H&H Civil Construction, LLC, 2110 Main St. Collins, WI 54207, phone (920) 772-4422.

NOTE: DETAILS MAY BE AVAILABLE FROM THE CITY REGARDING THE ARTIFICIAL TURF DESIGN

