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## SECTION 01 43 26.01

### SPECIAL INSPECTIONS AND STRUCTURAL TESTING

#### PART 1 - GENERAL

##### 1.01 GENERAL REQUIREMENTS

- A. Special Inspections and Structural Testing shall be in accordance with Chapter 17 of the 2018 International Building Code as adopted by New York State (BCNYS).
- B. The program of Special Inspection and Structural Testing is a Quality Assurance program intended to ensure that the work is performed in accordance with the Contract Documents.
- C. This specification section is intended to inform the Contractor of the Owner's quality assurance program and the extent of the Contractor's responsibilities. This specification section is also intended to notify the Special Inspector, Testing Laboratory, and other Agents of the Special Inspector of their requirements and responsibilities.
- D. Where application is made to the building official for construction as specified in Section 105 of the BCNYS, the Owner or the Owner's authorized agent, other than the Contractor, shall employ one or more approved agencies to provide special inspections and tests during construction and identify the approved agencies to the building official. These special inspections and tests are in addition to the inspections by the Building Official and by the Contractor, on his behalf.

##### 1.02 SCHEDULE OF INSPECTIONS AND TESTS

- A. Required inspections and tests are described in the Schedule of Special Inspections provided in Part 3 of this specification and in the individual specification sections for the items to be inspected or tested.

##### 1.03 QUALIFICATIONS

- A. The Special Inspector shall be a licensed Professional Engineer, Structural Engineer or as specified in the Schedule of Special Inspections and Chapter 17 of the BCNYS, and who is approved by the Code Enforcement Official (CEO).
- B. The Testing Laboratory and individual technicians shall be approved by the CEO.
- C. The Testing Laboratory shall maintain a full time licensed Professional Engineer or Structural Engineer on staff who shall certify all test reports. The Engineer shall be responsible for the training of the testing technicians and shall be in responsible charge of the field and laboratory testing operations.

- D. The minimum qualifications for testing agency laboratory personnel, and the minimum technical requirements for equipment and procedures utilized in the testing and inspection of construction and materials used in construction shall comply with ASTM E329 (Latest Edition) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

#### 1.04 SUBMITTALS

- A. The Special Inspector and Testing Laboratory shall submit to the CEO for review a copy of their qualifications which shall include the names and qualifications of each of the individual inspectors and technicians who will be performing inspections or tests. The Testing Laboratory shall also submit to the CEO for review, in accordance with ASTM E329, a certificate of accreditation, including the scope of accreditation.
- B. Approved Fabricators: Special Inspections are not required for work done on the premises of a fabricator registered and approved to perform such work without special inspection. See Section 1704.2.5 of the Building Code of New York State for conditions of approval.
  - 1. Certificate of Compliance upon completion of fabrication. The “Fabricator’s Certificate of Compliance” form is provided with the *Statement of Special Inspections*.

#### 1.05 CONTRACTOR RESPONSIBILITIES

- A. The Contractor shall cooperate with the Special Inspector and his agents so that the Special Inspections and testing may be performed without hindrance.
- B. The Contractor shall review the *Statement of Special Inspections* and shall be responsible for coordinating and scheduling inspections and tests. The Contractor shall notify the Special Inspector or Testing Laboratory at least 5 days in advance of a required inspection or test. Uninspected work that required inspection may be rejected solely on that basis.
- C. The Contractor shall provide incidental labor and facilities to provide access to the work to be inspected or tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, storage and curing of test samples.
- D. The Contractor shall keep at the project site the latest set of construction drawings, field sketches, approved shop drawings, and specifications for use by the inspectors and testing technicians.
- E. The Special Inspection program shall in no way relieve the Contractor of his obligation to perform work in accordance with the requirements of the Contract Documents or from implementing an effective Quality Control program. The Contractor’s quality control personnel shall first review all work that is to be subjected to Special Inspections.

- F. The Contractor shall be solely responsible for construction site safety.
- G. When required by the *Statement of Special Inspection's* "Quality Assurance Plan" each Contractor responsible for the construction or fabrication of main seismic or wind force resisting systems, designated seismic systems, or seismic or wind resisting components shall submit to the CEO and the Owner a "Statement of Responsibility". If required the Contractor's "Statement of Responsibility" form is provided with the *Statement of Special Inspections*.

#### 1.06 LIMITS ON AUTHORITY

- A. The Special Inspector or Testing Laboratory may not release, revoke, alter, or enlarge on the requirements of the Contract Documents.
- B. The Special Inspector or Testing Laboratory will not have control over the Contractor's means and methods of construction.
- C. The Special Inspector or Testing Laboratory shall not be responsible for construction site safety.
- D. The Special Inspector or Testing Laboratory has no authority to stop the work.

#### 1.07 STATEMENT OF SPECIAL INSPECTIONS

- A. The *Statement of Special Inspections* will be prepared and maintained by the Registered Design Professional in Responsible Charge (RDP).
- B. The *Statement of Special Inspections* shall be submitted with the application for Building Permit.

#### 1.08 RECORDS AND REPORTS

- A. Detailed daily reports shall be prepared of each inspection or test and submitted to the Special Inspector. Reports shall be submitted to the Special Inspector within 5 days of the inspection or test. The "Special Inspection Daily Report" form is provided with the *Statement of Special Inspections*. Daily reports shall include:
  - 1. Project Name and Location,
  - 2. Date of test or inspection,
  - 3. Time of Inspection start and end,
  - 4. Type of inspection "Continuous" or "Periodic",
  - 5. Name of inspector or technician,
  - 6. Location of specific areas tested or inspected,
  - 7. Description of test or inspection and results,
  - 8. Applicable ASTM standard(s),
  - 9. Weather conditions,
  - 10. Current item(s) of construction needing corrective action,
  - 11. Previously reported items of construction requiring corrective action that have been corrected,

12. Previously reported items of construction requiring corrective action that have not been corrected,
  13. Changes to Contract Documents authorized by the RDP,
  14. Engineer's seal and signature.
- B. The Special Inspector shall submit interim reports to the CEO, the Special Inspection Coordinator, the RDP, and the Contractor at the end of each week. The interim report(s) shall include all inspections and test reports received that week along with a completed "Special Inspection Weekly (Interim) Report" form provided with the *Statement of Special Inspections*.
- C. Any discrepancies from the Contract Documents found during a Special Inspection shall be immediately reported to the Contractor for correction. If the discrepancies are not corrected, the Special Inspector shall notify the CEO, Special Inspection Coordinator, and the RDP by telephone, email, or fax. Reports shall document all discrepancies identified, exact location, reference to applicable plan sheets, details and specifications and the resolution or corrective action taken.
- D. The Testing Laboratory shall immediately notify the Special Inspector, Special Inspection Coordinator, the RDP and the Contractor by telephone, email, or fax of any test results that fail to comply with the requirements of the Contract Documents.
- E. Upon completion of the work requiring Special Inspections, each inspection agency and testing laboratory shall provide a statement to the Special Inspector that all work was completed in conformance with the Contract Documents and that all appropriate inspections and tests were performed.

#### 1.09 FINAL REPORT OF SPECIAL INSPECTIONS

- A. The "Final Report of Special Inspections" shall be completed by the Special Inspector and submitted to the CEO prior to the issuance of a Certificate of Use and Occupancy. Concurrent with submission of the "Final Report of Special Inspections" to the CEO, the "Final Report of Special Inspections" shall be submitted to the Special Inspection Coordinator, and the RDP. The "Final Report of Special Inspections" form is provided with the *Statement of Special Inspections*.
- B. The "Final Report of Special Inspections" will certify that all required inspections have been performed and the report will itemize any discrepancies that were not corrected or resolved.

## PART 2 - PRODUCTS

(NOT USED)

## PART 3 - EXECUTION

### 3.01 STATEMENT OF SPECIAL INSPECTIONS

A. See Statement of Special Inspections attached to this Section.

### 3.02 SCHEDULE OF INSPECTION AND TESTING AGENCIES

A. See Schedule of Special Inspection and Testing Agencies attached to this Section.

END OF SECTION

# Statement of Special Inspections



Project:	Tompkins County Recycling Center
Location:	Tompkins County Recycling Center
Owner:	Tompkins County
Address:	122 Commercial Ave., Ithaca, New York, 14850
Registered Design Professional in Responsible Charge:	Matthew Fuller, P.E.

This *Statement of Special Inspections* is submitted as a condition for permit issuance in accordance with the Special Inspection and Structural Testing requirements of the 2018 International Building Code as amended by New York State (IBCNYS). It includes a schedule of Special Inspection services applicable to this project as well as the name of the Special Inspection Coordinator and the identity of other approved agencies to be retained for conducting these inspections and tests. This *Statement of Special Inspections* encompasses the following disciplines:

- ☒ Structural      ☐ Mechanical/Electrical/Plumbing  
☐ Architectural      ☐ Other: \_\_\_\_\_

The Special Inspection Coordinator shall keep records of all inspections and shall furnish inspection reports to the Building Code Enforcement Official (CEO) and the Registered Design Professional in Responsible Charge (RDP). Discovered discrepancies shall be brought to the **immediate** attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the **immediate** attention of the CEO, the RDP in Responsible Charge and the Special Inspection Coordinator. The Special Inspection program does not relieve the Contractor of his or her responsibilities as defined in the Contract Documents.

Interim reports shall be submitted to the CEO and the RDP in Responsible Charge at a frequency as noted below. Detailed daily Special Inspection reports shall be submitted to the Special Inspector within (5) five days of item inspected.

When required by the *Statement of Special Inspection's "Quality Assurance Plan"* each Contractor responsible for the construction or fabrication of main seismic or wind force resisting systems, designated seismic systems, or seismic or wind resisting components shall submit to the CEO and the Owner a *Statement of Responsibility*. The Contractor's *Statement of Responsibility* form is provided with this *Statement of Special Inspections*.

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per section 1704.2.5 of the IBCNYS must submit a *Fabricator's Certificate of Compliance* at the completion of fabrication. The *Fabricator's Certificate of Compliance* form is provided with this *Statement of Special Inspections*.

A *Final Report of Special Inspections* documenting completion of all required Special Inspections, testing and correction of any discrepancies noted in the inspections shall be submitted prior to issuance of a Certificate of Use and Occupancy. The *Final Report of Special Inspections* form is provided with this *Statement of Special Inspections*.

Job site safety and means and methods of construction are solely the responsibility of the Contractor.

Interim Report Frequency: *Weekly (a weekly report form is provided with this Statement of Special Inspections)* or ☐ per attached schedule.

Prepared by:

Matthew C. Fuller, P.E.  
(type or print name)

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
*Design Professional Seal*

Owner's Authorization:

Building Code Enforcement Official's Acceptance:

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date



# Schedule of Inspection and Testing Agencies

This Statement of Special Inspections/Quality Assurance Plan includes the following building systems:

- |  |  |
|--|--|
| <input type="checkbox"/> Soils and Foundations             | <input type="checkbox"/> Spray Fire Resistant Material         |
| <input checked="" type="checkbox"/> Cast-in-Place Concrete | <input type="checkbox"/> Wood Construction                     |
| <input type="checkbox"/> Precast Concrete                  | <input type="checkbox"/> Exterior Insulation and Finish System |
| <input type="checkbox"/> Masonry                           | <input type="checkbox"/> Mechanical & Electrical Systems       |
| <input type="checkbox"/> Structural Steel                  | <input type="checkbox"/> Architectural Systems                 |
| <input type="checkbox"/> Cold-Formed Steel Framing         | <input type="checkbox"/> Special Cases                         |

Special Inspection Agencies	Firm	Address, Telephone, e-mail
1. Special Inspection Coordinator	TBD	
2. Concrete Special Inspector	TBD	
3.		
5.		

Note: The inspectors and testing agencies shall be independent of the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official, prior to commencing work.

# Qualifications of Inspectors & Testing Technicians

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The qualifications of all personnel performing Special Inspection activities are subject to the approval of the Building Official. The credentials of all Inspectors and testing technicians shall be provided.

## MINIMUM QUALIFICATIONS FOR SPECIAL INSPECTORS

CATEGORY	MINIMUM QUALIFICATIONS
Reinforced Concrete	<ol style="list-style-type: none"> <li>1. Current ICC Reinforced Concrete Special Inspector or ACI Concrete Construction Inspector</li> <li>2. Concrete field testing can be by an ACI Concrete Field Testing Technician with Grade 1 certification.</li> <li>3. Engineer-in-Training (EIT) with relevant experience.</li> <li>4. New York State Registered Design Professional Engineer (RDP) with relevant experience.</li> </ol>
Prestressed Concrete	<ol style="list-style-type: none"> <li>1. Precast Concrete; Current ICC Reinforced Concrete certification, and ICC prestressed concrete certification, and ACI Concrete Field Testing Technician with Grade 1 certification plus one year of relevant experience.</li> <li>2. Engineer-in-Training (EIT) with relevant experience.</li> <li>3. RDP with relevant experience.</li> </ol>
Welding	<ol style="list-style-type: none"> <li>1. Current AWS Certified Welding Inspector.</li> <li>2. Current ICC Structural Steel and Welding Certificate plus one year of relevant experience.</li> <li>3. Current Level II certification from the American Society for Non-Destructive Testing (NDT).</li> <li>4. Current NDT Level III provided previously certified as NDT Level II.</li> </ol>
High-Strength Bolting & Steel Frame Inspection	<ol style="list-style-type: none"> <li>1. Current ICC Structural Steel and Welding certification and one year of relevant experience.</li> <li>2. Engineer-in-Training (EIT) with relevant experience.</li> <li>3. RDP with relevant experience.</li> </ol>
Masonry	<ol style="list-style-type: none"> <li>1. Current ICC Structural Masonry certification and one year of relevant experience.</li> <li>2. Engineer-in-Training (EIT) with relevant experience.</li> <li>3. RDP with relevant experience.</li> </ol>
Excavation and Filling; Verification of Soils	<ol style="list-style-type: none"> <li>1. Current Level II certification in geotechnical engineering technology/construction from the National Institute for Certification in Engineering Technologies (NICET).</li> <li>2. Engineer-in-Training (EIT) with relevant experience.</li> <li>3. RDP with relevant experience.</li> </ol>
Wood Construction	<ol style="list-style-type: none"> <li>1. Special Inspector approved by the Building Code Enforcement Official.</li> <li>2. Engineer-in-Training (EIT) with relevant experience.</li> <li>3. RDP with relevant experience.</li> </ol>
Inspection of Fabricators	<ol style="list-style-type: none"> <li>1. Precast Concrete; Current ICC Reinforced Concrete certification plus one year of relevant experience.</li> <li>2. Structural Steel: see welding requirements.</li> <li>3. Pre-fabricated Wood Trusses: Special Inspector approved by the Building Code Enforcement Official.</li> </ol>

# Quality Assurance Plan

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## Quality Assurance for Seismic Resistance

Seismic Design Category *NA*

Quality Assurance Plan Required (Y/N) *NA*

Description of seismic force resisting system(s), designated seismic system(s), and additional seismic system(s) and component(s):

Seismic Force Resisting System(s) – *NA*

Designated Seismic System(s) – *NA*

Additional Seismic System(s) and Component(s) – *NA*

## Quality Assurance for Wind Requirements

Basic Wind Speed (3 second gust) *NA*

Wind Exposure Category *NA*

Quality Assurance Plan Required (Y/N) *NA*

Description of main wind force resisting system(s) and designated wind resisting component(s):

Main Wind Force Resisting System(s) – *NA*

Designated Wind Resisting Components(s) – *NA*

## Statement of Responsibility: *NA*

Each contractor responsible for the construction or fabrication of a system or component designated above must submit a Statement of Responsibility.

# Qualifications of Inspectors and Testing Technicians

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The qualifications of all personnel performing Special Inspection and testing activities are subject to the approval of the Building Official. The credentials of all Inspectors and testing technicians shall be provided if requested.

## Key for Minimum Qualifications of Inspection Agents:

When the Registered Design Professional in Responsible Charge deems it appropriate that the individual performing a stipulated test or inspection have a specific certification or license as indicated below, such designation shall appear below the *Agency Number* on the Schedule.

PE/SE	Structural Engineer – a licensed SE or PE specializing in the design of building structures
PE/GE	Geotechnical Engineer – a licensed PE specializing in soil mechanics and foundations
EIT	Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination with relevant experience.

### American Concrete Institute (ACI) Certification

ACI-CFTT	Concrete Field Testing Technician – Grade 1
ACI-CCI	Concrete Construction Inspector
ACI-LTT	Laboratory Testing Technician – Grade 1&2
ACI-STT	Strength Testing Technician

### American Welding Society (AWS) Certification

AWS-CWI	Certified Welding Inspector
AWS/AISC-SSI	Certified Structural Steel Inspector

### American Society of Non-Destructive Testing (ASNT) Certification

ASNT	Non-Destructive Testing Technician – Level II or III.
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### International Code Council (ICC) Certification

ICC-SMSI	Structural Masonry Special Inspector with current registration, and one (1) year of relevant experience)
ICC-SWSI	Structural Steel and Welding Special Inspector
ICC-SFSI	Spray-Applied Fireproofing Special Inspector
ICC-PCSI	Prestressed Concrete Special Inspector
ICC-RCSI	Reinforced Concrete Special Inspector

### National Institute for Certification in Engineering Technologies (NICET)

NICET-CT	Concrete Technician – Levels I, II, III & IV
NICET-ST	Soils Technician – Levels I, II, III & IV
NICET-GET	Geotechnical Engineering Technician – Levels I, II, III & IV

ITEM	AGENCY # (QUALIF.)	SCOPE	SPECIAL INSPECTION (CONTINUOUS)	SPECIAL INSPECTION (PERIODIC) <sup>a</sup>
1. Mix Design	#_ ACI-CFTT ACI-CCI ICC-RCSI PE/SE EIT	Verify prior to concrete placement that concrete mix to be placed complies with the approved mix design and the Contract Documents for the item being constructed. Construction covered includes building and structure foundations and walls, floor slabs, beams, and equipment pads.		X
2. Reinforcement Installation	#_ ACI-CCI ICC-RCSI PE/SE EIT	Verify prior to concrete placement that the size, spacing, cover, positioning, condition, splices, and grade of reinforcing for Item 1 construction complies with the Contract Documents.		X
3. Concrete Placement	#_ ACI-CCI ICC-RCSI PE/SE EIT	Continuously verify that placement of concrete and concrete placement techniques for Item 1 construction are in compliance with the Contract Documents.	X	
4. Sampling and Testing of Concrete	#_ ACI-CFTT ACI-CCI ICC-RCSI PE/SE EIT	For Item 1 construction sample, test and report concrete slumps (ASTM C143), air-contents (ASTM C231 or C173), temperatures (ASTM C1064), and strengths, in accordance with the Contract Documents.	X	
5. Formwork	#_ ACI-CCI ICC-RCSI PE/SE EIT	Verify prior to concrete placement for Item 1 construction that formwork shapes, locations, and dimensions for concrete elements being formed comply with the Contract Documents.		X
6. Curing and Protection	#_ ACI-CCI ICC-RCSI PE/SE EIT	Verify prior to concrete placement, and periodically during the specified period of curing and protection, the means, methods, and maintenance of curing and protection of placed concrete for Item 1 construction are in compliance with the Contract Documents.		X

- a. "Periodic" rate of Special Inspection shall be defined as part-time or intermittent observation of work requiring Special Inspection by an approved Special Inspector who is present in the area where the work has been, or is being performed, and at the completion of work being observed, but prior to concealment. Specifically, "Periodic" Special Inspection shall begin at the commencement of an item to be inspected, at the mid-point of item construction, and at completion of item construction prior to concealment.

# Contractor's Statement of Responsibility

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Each contractor responsible for the construction or fabrication of a system or component designated in the Quality Assurance Plan must submit a Statement of Responsibility.

Project:

Contractor's Name:

Address:

License No.:

Description of designated building systems and components included in the Statement of Responsibility:

## Contractor's Acknowledgment of Special Requirements

I hereby acknowledge that I have received, read, and understand the Quality Assurance Plan and Special Inspection program.

I hereby acknowledge that control will be exercised to obtain conformance with the construction documents approved by the Building Official.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

## Contractor's Provisions for Quality Control

Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of reports are attached to this Statement.

Identification and qualifications of the person(s) exercising such control and their position(s) in the organization are attached to this Statement.

# Fabricator's Certificate of Compliance

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Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per section 1704.2 of the IBCNYS must submit a *Fabricator's Certificate of Compliance* at the completion of fabrication.

Project:

Fabricator's Name:

Address:

Certification or Approval Agency:

Certification Number:

Date of Last Audit or Approval:

Description of structural members and assemblies that have been fabricated:

I hereby certify that items described above were fabricated in strict accordance with the approved construction documents.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Title

Attach copies of fabricator's certification or building code evaluation service report and fabricator's quality control manual

## SPECIAL INSPECTION DAILY REPORT

City/County of

Permit No.:

Date:

Project Name/Address:

\_\_\_\_\_

Inspection type(s) coverage:

☐ Continuous

☐ Periodic

Inspection time: Beginning:

Ending:

Describe inspections made, including locations: \_\_\_\_\_

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

Tests performed:

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

New items needing correction:

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

Corrected items from previous reports:

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

Item corrections remaining incomplete:

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

Changes to approved plans authorized by registered design professional in responsible charge:



Comments:

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To the best of my knowledge, work inspected was in accordance with the building department approved plans, specifications and applicable workmanship provisions of the IBCNYS except as noted above.

Signed: \_\_\_\_\_  
Print Full Name: \_\_\_\_\_

Inspection Agency: \_\_\_\_\_  
ID / Certificate Number: \_\_\_\_\_

## SPECIAL INSPECTION WEEKLY (INTERIM) REPORT

City/County of

Permit No.:

Date:

Project Name/Address:

Total inspection time each day:

Date							
Hours							
Inspection Type							
Frequency (P or C)							
Location							

P – Periodic inspection

C – Continuous inspection

Describe inspections made, including locations:

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Tests performed:

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New items needing correction:

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Corrected items from previous reports:

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Item corrections remaining incomplete:

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Changes to approved plans authorized by registered design professional in responsible charge:

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Comments:

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To the best of my knowledge, work inspected was in accordance with the building department approved plans, specifications and applicable workmanship provisions of the IBC except as noted above.

Signed: \_\_\_\_\_ Inspection Agency: \_\_\_\_\_  
Print Full Name: \_\_\_\_\_ ID /Certificate Number: \_\_\_\_\_

# Final Report of Special Inspections

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Project:

Location:

Owner:

Owner's Address:

Architect of Record: *Barton & Loguidice, D.P.C.*

Structural Engineer of Record: *Matthew Fuller, P.E.*

To the best of my information, knowledge and belief, the Special Inspections required for this project, and itemized in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

*(Attach continuation sheets if required to complete the description of corrections.)*

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,  
Special Inspector

\_\_\_\_\_  
(Type or print name)

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
*Licensed Professional Seal*

## SECTION 02 41 19

### SELECTIVE DEMOLITION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

##### 1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

##### 1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
  1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

1.5 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.6 QUALITY ASSURANCE

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
1. Before selective demolition, Owner will remove the following items:
    - a. Countertop appliances, refrigerator, freestanding shelving.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.
  2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video .
  - 1. Inventory and record the condition of items to be removed and salvaged.
  - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

### 3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Arrange to shut off utilities with utility companies.

2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
  - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
  - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
  - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

### 3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
  1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

### 3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:



1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 0.5 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Transport items to Owner's storage area on-site designated by Owner.
4. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair 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.

### 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- B. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

### 3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

### 3.8 CLEANING

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

END OF SECTION

## SECTION 03 21 00

### REINFORCING STEEL

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for installing all Reinforcing Steel, welded wire reinforcement and accessories for cast-in-place concrete as shown on the Plans, as specified, and/or directed.

##### 1.02 REFERENCES

- A. Reference to standard specifications for the following organizations is intended to specify minimum standards for quality of materials and performance of workmanship, and for standard test methods.
  - 1. American Society for Testing and Materials (ASTM) Publications, Latest Edition
  - 2. American Concrete Institute (ACI) Standards, Latest Edition
  - 3. American Welding Society (AWS) Publications, Latest Edition
  - 4. American National Standards Institute (ANSI) Publications, Latest Edition
  - 5. Concrete Reinforcing Steel Institute (CRSI) Publications, Latest Edition

##### 1.03 SUBMITTALS

- A. Shop Drawings: Indicate bar sizes, spacings, locations and quantities of reinforcing steel and welded wire reinforcement sheets, bending and cutting schedules, and supporting and spacing devices. No work on fabricating or placing steel shall be done until such drawings and schedules have been approved.
- B. Manufacturer's Certificate: Submit certified copies of mill test report of reinforcement materials analysis.
- C. Welder's Certificate: Submit certification from welders employed on the work, verifying AWS qualification within the previous twelve months.

#### PART 2 - PRODUCTS

##### 2.01 MATERIALS

- A. Reinforcing steel bars shall be free from defects, kinks, bends, rust, scale or other irregularities. Welded wire reinforcement shall be of the electrically welded type, with wires arranged in rectangular or square patterns.

- B. Reinforcing bars shall be deformed billet steel meeting the requirements of ASTM A615 Grade 60.
- C. Steel welded wire reinforcement (WWR) shall meet the requirements of ASTM A1064.
- D. Stirrup steel shall be cold drawn steel wire meeting the requirements of ASTM A82.
- E. Where indicated, epoxy coated reinforcing bars shall be deformed billet steel meeting the requirements of ASTM A775, Grade 60.
- F. Where indicated, galvanized reinforcing bars shall be deformed billet steel meeting the requirements of ASTM A767, Grade 60.
- G. Accessory materials shall include: tie wire, minimum 16 gage annealed type. Epoxy-coated reinforcing bars shall be tied with plastic-; epoxy-; or nylon-coated tie wire. Chairs, bolsters, bar supports, and spacers shall be sized and shaped for strength and support of reinforcement during concrete placement conditions.

## 2.02 IDENTIFICATION AND PROTECTION OF REINFORCING BARS AND WELDED WIRE REINFORCEMENT:

- A. Reinforcing steel shall be delivered to the work in strongly tied bundles identified with metal tags corresponding to the bar schedules and diagrams. Identification marks shall show quantity, producing mill, bar size, type of steel and grade mark.
- B. All bars and WWR shall be stored off the ground and shall, at all times, be protected from moisture and be kept free from dirt, oil, or injurious coatings. Epoxy-coated reinforcing bars shall be stored on protective cribbing. If concreting is delayed for any considerable number of days after the reinforcing is placed in position, it shall be protected by covering with canvas or other satisfactory covering, or, if directed, shall be painted with a coat of neat cement grout.
- C. Any bar or WWR having a scaly rust shall be cleaned. Epoxy-coated reinforcing bars that are cut, welded or otherwise damaged shall be repaired with patching material conforming to ASTM A775 and done in accordance with the Material Manufacturer's recommendation. Galvanized reinforcing bars that are cut, welded or otherwise damaged shall be repaired with patching material conforming to ASTM A767 and done in accordance with the Material Manufacturer's recommendation. The Contractor will be required to replace bars exhibiting severely damaged coatings.

## PART 3 - EXECUTION

### 3.01 FABRICATION AND INSTALLATION:

- A. Metal reinforcing shall be properly fabricated in accordance to references specified.
- B. Metal reinforcing shall be properly placed in accordance to CRSI, ACI 301, ACI 318, ACI SP-66, as shown on the approved Shop Drawings and as herein directed.
- C. Bars shall be bent in the shop to the shapes shown or required. Field bending shall be done only with the written approval of the Engineer. Field welding shall not be allowed without direct approval and supervision of the Engineer.
- D. Unless otherwise shown, splices in tension reinforcement shall not be permitted, and splices in compression reinforcement shall be lapped 40 diameters. All bar splices shall be staggered, wherever possible. Locate splices not indicated on drawings, at point of minimum stress. Splice locations must be approved by the Engineer.
- E. Reinforcing shall be securely tied and supported and must not be displaced during concrete placing operations. Epoxy-coated reinforcing bars shall rest on coated wire bar supports, or other acceptable materials. Dowels must be wired in place before concreting begins. All metal shall be kept away from exposed surfaces of concrete.
- F. Conduit in slabs on grade shall be placed in a depression below the slab and the reinforcement run continuous over conduit. Conduit in slabs on forms shall be above the bottom reinforcing and below the top reinforcing. No conduit is permitted in thin joist slabs.
- G. Cutting of bars to clear openings in walls or slabs is strictly prohibited. Warp bars around such openings.
- H. Provide two #5 diagonal bars at each corner of every rectangular opening in walls, unless otherwise shown on the Plans.
- I. All slabs, unless otherwise shown on the Plans, to be reinforced with not less than 6 x 6 - W2.9 x W2.9 WWR (welded wire reinforcement), supported on approved fabricated, corrosion resistant chairs and located as specified. Supports shall be spaced as required to continuously maintain the specified reinforcement location within the slab thickness prior to and during slab concrete placement.

- J. Placing of concrete shall not be scheduled until all of the reinforcing for the section is secured in place and the reinforcing and forms have been approved by the Engineer or his representative. Contractor shall notify the Engineer 24 hours prior to a concrete pour.
- K. Welded wire reinforcement in slabs is to be placed in the upper third of the depth of the slab. Lap 6" minimum. Reinforcement sheets shall be straightened as required before placement.
- L. Provide bent bars 6'-0" long of same size and spacing as horizontal bars for all corners of foundation walls, unless otherwise shown on the Plans.
- M. Do not displace or damage vapor barrier.
- N. For footing reinforcement - support bars on small precast concrete blocks; space at intervals as shown on the Plans and within minimum height specified above underside of slab or footing.
- O. Reinforcement shall not be bent after being partially embedded in hardened concrete.

### 3.02 CONCRETE PROTECTION FOR REINFORCEMENT:

- A. Unless otherwise shown or directed, concrete protection, measured from the surface of the bar, shall be the following:
  - 1. For concrete deposited against the ground, without the use of forms ..... 3 inches
  - 2. For formed concrete in contact with the ground ..... 2 inches
  - 3. For slabs and walls contacting water or sewage ..... 2 inches  
For beams, girders and columns not directly exposed to ground and weather ..... 1-1/2 inches
  - 4. For formed concrete exposed to the weather ..... 2 inches
  - 5. For slabs and walls, not directly exposed to ground, weather, water or sewage ..... 1 inch
- B. Exposed reinforcing bars intended for bonding with future extensions shall be protected from corrosion by a covering of concrete or other approved material.

### 3.03 FIELD QUALITY CONTROL

- A. Field inspection will be performed under the provisions of Section 03 30 00.

END OF SECTION

## SECTION 03 31 18

### CAST-IN-PLACE CONCRETE (MINOR CONSTRUCTION)

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for plain and reinforced Cast-In-Place Concrete (Minor Construction) work including accessory items of work herein described, as shown on the Plans, as specified, and/or directed.

##### 1.02 APPLICABLE SPECIFICATIONS, CODES AND STANDARDS

- A. Reference to standard specifications for the following organizations is intended to specify minimum standards for quality of materials and performance of workmanship, and for standard test methods.
  - 1. American Society for Testing and Materials (ASTM) Latest Edition.
  - 2. American Concrete Institute (ACI) Standards, Latest Edition.
  - 3. American Welding Society, Inc. (AWS) Publications Latest Edition.
  - 4. Standard Specifications - Construction and Materials, New York State Department of Transportation, Latest Edition, including Addenda thereto.

#### PART 2 - PRODUCTS

##### 2.01 MATERIALS

- A. All materials shown, specified or required to be incorporated in cast-in-place concrete shall be of finest quality, and shall be delivered, stored and handled so as to prevent damage.
- B. Portland Cement shall be a standard brand in compliance with ASTM C150 Type I. Only one brand shall be used for exposed work. Generally, Type I cement shall be used; however, Types II or III may be employed with the approval of the Engineer or if shown, or specified.
- C. Fine Aggregates shall be clean, sharp, natural sand, free from loam, clay, organic impurities or frozen materials and shall conform to ASTM C33 in all respects. Sand shall be tested for impurities in accordance with ASTM C40.

- D. Coarse Aggregates shall consist of strong, clean, crushed limestone or crushed gravel, free from harmful material and meeting all of the requirements of ASTM C33. Coarse aggregate shall also comply with New York State Department of Transportation Material Designation 703-02. Crushed limestone and crushed gravel shall meet the Physical Requirements (Testing) Designation 703-0201 and 703-0202, respectively.
- E. Water used in mixing concrete shall be clean and free from all acid, alkali or organic matter and shall be obtained from a public water supply unless specifically permitted otherwise by the Engineer.
- F. Ready Mix Concrete shall comply with ASTM Specification C94, this Specification, and used subject to the Engineer's approval.
- G. Admixtures, where shown or specified, shall be as follows:
1. Air entraining agent shall be "Daravair" or "Darex AEA" as manufactured by W.R. Grace Co., or Master Builder's "MBVR", or equal.
  2. Water reducing agent shall be Sika "Plastiment", Master Builder's "Pozzolith", W.R. Grace's "WRDA", or equal.
  3. High range water reducers or superplasticizers shall be Sika "Sikament-FF", W.R. Grace's "Daracem-100" or "WRDA-19", or equal.
  4. Concrete shrinkage reducer shall be Sika "SikaControl NS", Euclid "Eucon SRA Floor", Master Builder's "MasterLife SRA 035", or equal.
- H. Bonding Agent, where shown or specified, shall be "Dural 104" bonding compound manufactured by Dural International Corporation, "Sikadur 32 Hi Mod" by Sika Corporation, or equal.
- I. Forms shall be wood, metal, or other approved materials as follows:
1. Plywood shall be Commercial Standard Douglas Fir, moisture resistant, concrete form plywood, at least 5-ply 5/8" thick.
  2. Metal forms shall be as approved, and must produce surfaces equal to those specified for wood forms.
  3. Form oil shall be an approved non-staining mineral oil, such as "Duogaurd II" by W.R. Meadows, or equal.
  4. Form ties shall be of approved design, adjustable length and free of devices that will leave hole or depression larger than 7/8" diameter. When forms are removed no metal shall be left within 1" of finished surface.
- J. Premolded Filler, where shown or specified, shall be premolded, resilient, non-extruding type, 1/2-inch thick unless shown otherwise, full depth of concrete section as manufactured by Celotex Corporation, "Fibre Expansion Joint Filler" by W.R. Meadows, or equal.
1. Sample of the premolded filler proposed to be used shall be submitted to the Engineer for approval.



- K. Joint Sealant, where shown or specified, shall be elastomeric polyurethane sealant material, black in unexposed locations, and grey in exposed locations, and have balanced properties of elongation recovery and tensile strength, and shall be Sonneborn "Sonolastic NP1", Sika "Sikaflex 1A", or equal.
- L. Protective Covering for concrete finish slabs, where shown or specified, shall be "Orange Label Sisalkraft", Polyethylene Film as manufactured by Fortifiber Corp., or equal.
- M. Non-Shrink Grout, where shown or specified, shall be non-metallic, natural aggregate such as "Masterflow" as manufactured by Master Builders, "SikaGrout 212" as manufactured by Sika, or approved equal.
  - 1. Non-Shrink grout shall be used under structural steel column baseplates and all equipment baseplates. All work shall be done in strict accordance with the manufacturer's recommendations. At the request of the Engineer, the manufacturer's representative shall be called to the job site for consultation regarding detailed use of the grout.
- N. Liquid Hardener, where shown or specified, shall be "Lapidolith" as manufactured by Sonneborn, "Emery Top" as manufactured by L&M Construction Chemicals, Inc., or equal, and shall be compatible with later finishes.
- O. Curing Compound shall be acrylic based "Kure-N-Seal" as manufactured by Sonneborn, acrylic based "CS-309", or water based "VOCOMP-20" as manufactured by W.R. Meadows, or equal.
- P. Vapor Retarder, where shown or specified, shall be "Moistop" as manufactured by Fortifiber Corp. Vapor Barrier shall be "Premoulded Membrane Vaporseal" as manufactured by W.R. Meadows, or equal.
- Q. Perimeter Insulation, where shown or specified, shall be "Styrofoam Square Edge" as manufactured by the Dow Chemical Corporation, "Foamular 250" as manufactured by UC Industries, or equal.
- R. Abrasive Grits, where shown or specified, shall be "Korundum" by Concrete Service Materials Company, or equal.
- S. Metal Slab Joints, where shown or specified, shall be keyed type, minimum 18 gauge, galvanized steel by Heckmann Building Products, or equal.

2.02 SUBMITTALS: Submit the following:

- A. Certificates of Compliance:
  - 1. Cement, mill test reports
  - 2. Aggregates, sieve analyses

- B. Product Data and Samples:
  - 1. Submit manufacturer's information for any material listed under Section 2.01 that will be incorporated into this project.
  - 2. Submit samples as indicated in Section 2.01.
- C. Concrete mix design and compressive strength results of field trial batches for each class/type of concrete incorporated into the work.

## 2.03 CONCRETE TESTING

- A. As part of project Special Inspection requirements, the Owner shall directly employ (contract with) an approved commercial testing laboratory at their own expense to provide field sampling, testing and inspection of all concrete. Continuous inspection by the approved testing laboratory shall be provided during all concrete pours. The Special Inspector shall maintain a record set of plans showing date and amount of each placement, test results and temperature. If any portion of the work shows low test results, the Engineer may require additional testing, load tests, cored samples, and/or replacement of the faulty work, etc., at the Contractor's expense.
- B. Field concrete inspection: The approved testing laboratory, shall provide a competent field concrete inspector whose minimum duties shall be as follows:
  - 1. Collect and verify with each batch of concrete, before unloading at the site, a delivery ticket on which is printed, stamped, or written, information concerning said concrete. Have available for Engineer to review if requested.
  - 2. Check each truck on arrival to make sure that the concrete is not re-tempered.
  - 3. Make necessary slump tests for uniformity control.
  - 4. Make air tests and yield tests as required.
  - 5. Make any and all test cylinders as may be required in the Specifications.
  - 6. Transport cylinders from the site to the laboratory, or maintain cylinders on site if required.
  - 7. Notify the Engineers and/or his representative if any test results vary from the specified limits.
- C. Tests:
  - 1. Concrete shall be tested by an approved testing laboratory as follows:
    - a. Standard 6" x 12" compression cylinders shall be in compliance with C-39 in sets of six. Break 2 at 3 days, 2 at 7 days, and 2 at 14 days. Compression test cylinders shall be made as specified on the plans, but not less that one set shall be made for approval of each mix design, one set for first pour of 50 cubic yards or less, and one set for each additional pour of 50 cubic yards. If less than 50 cubic yards are placed in one day, one set shall be made for each day's pour.

- b. All test cylinders shall be cast, cured, transported and broken under laboratory conditions in accordance with the ASTM C31 and ASTM C39. All six cylinders of a test shall be taken from the middle third of a single load and as specified on the plans. Each cylinder shall be properly labeled with an identifying mark, the mix proportions, air content, amount of water, slump, and the location in the structure where the concrete was placed. Test reports shall include all this information. Distribute copies of reports as requested by the Engineer. Should any results be questionable, the Engineer shall be notified immediately so that corrective measures can be taken. Any test cylinder which has broken and fails to meet requirements shall be preserved for inspection by the Engineer.

## 2.04 INSPECTION

- A. Before each concrete placement, forms and reinforcing shall be inspected and approved by the Special Inspector. The Contractor shall give the Special Inspector at least 24 hours notice before such an inspection is required. No concrete placement shall be started until the Special Inspector has given approval. No concreting may be done in the absence of the Special Inspector without written permission of the Engineer.

## 2.05 CONCRETE MIX DESIGN

- A. The various classes of concrete shall be designated as follows, or as specified on the Plans:

MAXIMUM PERMISSIBLE WATER-CEMENT RATIOS FOR CONCRETE (WHEN STRENGTH DATA FROM TRIAL BATCHES OR FIELD EXPERIENCE ARE NOT AVAILABLE)					
CLASS	MIN. 28-DAY COMPRESSIVE STRENGTH IN PSI*	NON-AIR-ENTRAINED CONCRETE		AIR-ENTRAINED CONCRETE	
		ABSOLUTE RATIO BY WEIGHT	US GAL. PER 94-LB. BAG OF CEMENT	ABSOLUTE RATIO BY WEIGHT	US GAL. PER 94-LB. BAG OF CEMENT
A	5,000	**	**	**	**
B	4,000	0.44	5.0	0.35	4.0
C	3,000	0.58	6.6	0.46	5.2
D	2,500	0.67	7.6	0.54	6.1
E	2,000	0.71	8.0	-	-
<p>* 28-day strength. With most materials, water/cement ratios shown will provide average strengths greater than indicated in Section 5.4 of A.C.I. 318R-89 as being required.</p> <p>**For strength above 4,500 psi (non-air-entrained concrete) and 4,000 psi (air-entrained concrete) proportions shall be established by methods of Sections 5.3 or 5.4 of A.C.I. Building Code (A.C.I. 318R-89).</p>					

Unless otherwise specified, all concrete shall be Class "B", non-air-entrained except exposed concrete which shall be air-entrained. When foundation walls or grade beams are exposed to weather above grade, the entire wall shall be considered exposed concrete.

- B. Maximum size aggregates shall be used as follows unless otherwise designated by the Engineer.
- |    |        |   |
|----|--------|---|
| 1. | 1-1/2" | general work                            |
| 2. | 3/4"   | thin sections; heavy reinforcing; slabs |
| 3. | 3/8"   | floor toppings                          |
- C. Slump - Maximum:
- |    |   |    |
|----|---|----|
| 1. | Reinforced concrete - general             | 4" |
| 2. | Reinforced concrete - thin walls, columns | 5" |
| 3. | Non-reinforced concrete                   | 3" |
| 4. | Pavements, including sidewalks            | 3" |
- D. Air Content: Use an approved air entraining admixture. The entrained content shall be controlled between 4% - 6%. See Plans for concrete work requiring air entrainment.
1. For mixes containing coarse aggregate with a top size of 3/4" or smaller and for exposed concrete subject to frost and salt action, air contents shall be increased to the range of 5% - 7%.

## PART 3 - EXECUTION

### 3.01 BATCHING AND MIXING

- A. The Contractor shall have available at all times, sufficient approved materials such that, when once started, concreting shall be a continuous operation until the placing of the panel or section is completed. The top surface shall be generally level. When construction joints become necessary, they shall be made as hereinafter specified.
- B. All concrete shall be mixed not less than 60 revolutions in the drum of a modern power mixer, at the rated speed of rotation. Mix not less than an additional 30 revolutions after the addition of any further water to the mix.
- C. Transit-mixed concrete shall be transported to the job site unmixed and only after arrival at the job site shall mixing begin. All concrete shall be unloaded from the mixer within 45 minutes after completion of mixing. All concrete still remaining in the truck shall be rejected.

- D. The total time interval from the time the cement makes contact with the aggregate to the complete unloading from the mixer shall not exceed 90 minutes, unless such time is extended by the Engineer. The time may be reduced in hot weather or under unusual conditions, if unsatisfactory results are obtained.

### 3.02 FORMWORK

- A. The Contractor shall design and construct suitable and adequate formwork in conformance with A.C.I. 347R (latest edition). All shoring shall be properly braced to safely withstand all vertical, moving and lateral forces during the construction period. Responsibility for adequacy and safety rests with the Contractor. Materials shall be as stated in Paragraph 2.1.
- B. Set forms true to line and grade and make mortar-tight. Chamfer above grade exposed joints, edges, and external corners of concrete 3/4-inch, unless otherwise indicated. Before concrete placement, coat the contact surfaces of forms with a non-staining form coating compound. Do not use mineral oil on formed surfaces to be painted. Prevent concrete damage during form removal. Concrete for footings may be placed in excavations without forms upon inspection and approval by the Engineer. Excavation width shall be a minimum of 4 inches greater than finished dimensions indicated.
- C. It shall be the Contractor's responsibility to determine the time at which forms may be removed without endangering the structure, subject to the following limitations, unless documentation is provided to modify these requirements:
  - 1. Footing forms - 24 hours minimum; continue curing as specified.
  - 2. Wall forms - 2 days minimum for ten (10) feet high. Add one (1) day for each additional five (5) feet of height; continue curing as specified.

### 3.03 JOINTS FOR CONCRETE

- A. Expansion Joints:
  - 1. Expansion joints shall be constructed where shown and as directed. Reinforcement, corner protection angles or other fixed items embedded or bonded into concrete shall not be run continuously through expansion joints. Reinforcement shall be discontinued 2 inches from the joint face. A slightly rounded edging shall be provided to finish neatly all edges around expansion joints.
  - 2. Preformed expansion joint filler material and sealant, where shown on the drawings, shall be as specified in Paragraph 2.1.
- B. Construction Joints:
  - 1. The location of construction joints shall be chosen by the Contractor and shall be subject to the Engineer's approval except where specifically located on the Plans. Horizontal construction joints in walls will not be permitted.

2. Reinforcing shall be discontinuous through a construction joint, unless otherwise noted on drawings. As shown or specified on the drawings, additional No. 3 reinforcing bars spaced at 12-inches on center shall be placed horizontally in each construction joint at the center of the section. These bars shall be 4-feet long and shall extend 2-feet on each side of the joint. Reinforcement projecting through joint shall be kept clean. As indicated on the drawings, all construction joints shall be provided with a keyway.
  3. As indicated on drawings, a metal keyed floor slab joint may be used.
- C. Contraction (Control) Joints.
1. Contraction joints shall be located as shown on the drawings or as directed. Reinforcement through the joint shall be continuous as shown on the drawings and/or as directed by the Engineer.
  2. Sawcut contraction joints (Type "A") shall be made by cutting the concrete surface and filling with the sealant material as specified under paragraph 2.1. Cutting shall be done after the surface is firm enough not to be damaged by the cutting blade. Time of cutting shall be approved by the Engineer.
  3. Formed contraction joints (Type "B") shall be made by tooling with a 1/4-inch radius edging tool and filled with the sealant material as specified under paragraph 2.1.
  4. Premolded Contraction Joints (Type "C") shall be "Kold-Seal Zipper Strip" by Vinylex or "Zip Cap Control Joint" by Greenstreak Products, or equal.

### 3.04 INSERTS AND SLEEVES

- A. The Contractor shall cooperate with all other Contractors in permitting the placing of all necessary sleeves, conduit, or inserts for hangers for their trades. The Contractor shall notify the trades of all pours in ample time for the responsible Contractor to place all embedded items, sleeves, slots, holes or chases.
- B. Accurately set all slots, chases, anchor bolts, opening, etc. All inserts for hanging mechanical equipment shall be provided and set by the Contractor for the trade involved. All sleeves for piping passing through floors and walls shall be provided by the Contractor for the trade involved and set by the General Contractor.
- C. All conduit which must be placed in concrete slabs shall be installed after, and above the bottom reinforcing, but before, and under the top reinforcing. Where conduit cross-overs are necessary, they shall be located so that reinforcing is not displaced from its specified position.

- D. If, in the judgement of the Engineer, embedded items are located or grouped in a manner that will weaken the structure, the Contractor shall take the necessary corrective steps.
- E. All inserts and sleeves where the outside diameter is greater than the spacing between the reinforcing steel, the reinforcing bars shall be warped around such inserts and sleeves. Unless shown otherwise on the drawings, provide, as a minimum, two #4 diagonal bars per face at 90 degrees to each other all around the inserts and sleeves.
- F. Where openings are left in new concrete or are made in existing concrete for the insertion of wall castings, pipes or other fixtures, the space around these fixtures shall be made watertight by completely filling with a non-shrinking concrete containing an admixture of "SikaSet-C", "Anti-Hydro" Concrete Waterproofing Agent, or equal.

### 3.05 CONVEYING AND PLACING CONCRETE

- A. The placing or depositing of all concrete shall be done in accordance with A.C.I. 304R (latest edition) "Guide for Measuring, Mixing, Transporting and Placing Concrete" and as modified herein.
- B. Before placing concrete, all debris, water, snow and ice shall be removed from places to be occupied by concrete. Wood forms shall be wetted except in freezing weather or oiled, and the reinforcement cleaned of ice or other coatings.
- C. Conveying, transporting, and placing shall be done as rapidly as practicable and without segregation, loss of ingredients, and without unnecessary re-handling. The tempering of concrete will not be permitted.
- D. Spade and work the coarse aggregate away from forms and work concrete around reinforcement to avoid air pockets, voids, and honeycombed sections. The use of a mechanical vibrator is mandatory, but concrete must not be over-vibrated. Hand spading will be required in addition to mechanical vibration. Maintain spare vibrator(s) at site for use in case of breakdowns.
- E. Screed all work to level surfaces at the proper elevations. Rake surfaces to provide bond for floor finishes where specified.
- F. No concrete shall be deposited under water without written permission of the Engineer and then only in accordance with his directions. Proper tremie equipment and techniques must be used, should the need arise.

### 3.06 PROTECTION AND CURING

- A. All concrete shall be protected against injury by sun, rain, freezing, mechanical damage, or premature drying. All concrete shall be maintained above 50°F in a moist or wet condition for at least the first 7 days after placement.
- B. On vertical surfaces keep forms on, or cover with burlap blankets, kept wet.
- C. On horizontal surfaces and floors to receive later finishes, cover with wet burlap, wet sand, or curing paper and keep saturated. Cement finish floors shall be covered with protective covering material with lapped and sealed edges after the concrete has set sufficiently to carry worker's weight. Covering shall remain in place until floor is cleaned. Weight covering with planks as required to hold it in place.
- D. Cold weather protection shall conform to A.C.I. 306R (latest edition) "Cold Weather Concreting" except as herein modified.
  - 1. Prior to pouring, it shall be the Contractor's responsibility to keep the forms free from snow, ice, mud or debris at all times, by means of covers, enclosures, live steam or heating below the forms, as necessary. Use of torches, open flames, salts, straw, hay or chemical is prohibited.
  - 2. When air temperature is 40°F, or less, use only heated concrete, delivered to the forms at temperatures between 65°F and 85°F. All portions of freshly poured concrete shall be continually maintained at a temperature of not less than 50°F for seven days. Specified temperature shall be maintained by heated enclosures, insulating blankets, insulated forms, or whatever approved methods are required to attain the specified result.
  - 3. Concrete shall not be poured on frozen soil. After pouring, protect against freezing and heaving of subgrade. Any frozen concrete will be rejected and removed at the Contractor's expense. Accelerating admixtures shall not be accepted in lieu of winter protection.
- E. Hot weather protection shall conform to A.C.I. 305R (latest edition) "Hot Weather Concreting" except as modified herein.
  - 1. During warm dry weather special care and precautions should be taken to prevent premature setting which may cause shrinkage and surface checking. No concrete shall be placed at temperatures above 90°F without approval of the Engineer.
- F. No water (except curing spray) shall be allowed to come in contact with the concrete or masonry surface for a minimum of 24 hours. Should the rising water place a stress on the concrete, proper bracing shall be provided. Loading shall not occur without prior approval by the Engineer, and proper safety precautions shall be the responsibility of the Contractor.



- G. Curing compound may be used as specified in Paragraph 2.1 provided discoloration does not occur and application is in accordance with manufacturer's direction and is compatible with concrete finish.

### 3.07 SLABS ON GROUND

- A. Subgrade and base to be prepared as specified in Contract Documents.
- B. Form depressed ribs under partitions as required by sloping gravel, or provide permanent side forms to retain gravel.
- C. Trench subgrade for electric conduit as detailed on Plans. All reinforcing shall be above electric conduit.
- D. Place slabs of thickness shown on Plans, vibrate, screed, float level, and finish as specified below.

### 3.08 CONCRETE FINISHES - FORMED SURFACES

- A. After the forms are removed, all concrete surfaces shall be inspected, and any poor joints, voids, stone pockets or other defective areas noted by the Engineer shall be repaired immediately at the Contractor's expense by cutting away the unsound area to a minimum depth of 1 inch, and refilling with mortar mixed using the same brand of cement as the original pour. Edges of the patch shall be square with the face, with feather-edging prohibited. Obtain approval of corrective action prior to repair.
- B. Care shall be taken to saturate the patched area and holes shall be filled in 1/2-inch layers with a delay for an initial set to take place before the succeeding layer is applied. If, in the opinion of the Engineer, improper consolidation is too extensive, or if the structure appears weakened by the voids, complete removal of the concrete in question may be required. Patches shall be kept moist for a minimum of three days.

### 3.09 FLOOR AND SLAB FINISHING

- A. Finished floors and slabs shall be level to within 1/8" of finish floor elevation in ten feet. If this variation occurs, it must not be abrupt, but must taper so that the 1/8" variation takes place in not under 4 feet. Areas with drains shall have the surfaces sloped uniformly and true to the effect that no surface ponding occurs. If required by the Engineer, replace, grind or furnish underlayment to correct the variation, at the Contractor's expense. All floors and slabs shall be cured and protected as specified.
- B. Under quarry tile and ceramic tile screed and float top surface of slab, after concrete has been compacted, to accurate lines and levels as required to receive these materials. Floors receiving a tile finish are indicated on the Plans.

- C. Where exposed concrete finish is specified, provide a steel troweled finish. After concrete has set sufficiently to carry the weight of the workman, float with motor-driven rubber disc machine to thoroughly compact and close any surface voids.
- D. Dusting with dry cement or cement sand mixtures, to hasten drying, is prohibited. Dry time shall be controlled by controlling the water content and slump of the concrete when placed.
- E. Liquid hardener, as specified in Paragraph 2.1, shall be applied to exposed concrete finish floors where shown on the Contract Drawings. Cure floors thoroughly. Hardener shall be applied in accordance with Manufacturer's directions in at least two coat application, allowing 24 hours between coats. Coverage, for each coat, shall be one gallon per 100 square feet. After final coat is complete and dry, remove surplus hardener by scrubbing and mopping with water.
- F. Unless specified otherwise on the Plans, a float finish shall be applied to all exterior concrete and those areas not intended for occupancy, such as culvert inverts, bottoms of manholes and catch basins, pads, etc. Sidewalks, walkways, or exterior ramps shall be given a broom finish, perpendicular to traffic, sufficient to leave marks without appreciable disturbance of the surface.

### 3.10 MISCELLANEOUS CONCRETE WORK

- A. Pour all sump pits, canopies, copings and provide all other miscellaneous concrete and cement work shown on the drawings. All such concrete shall be reinforced as shown. Provide all cement filled stair treads as detailed. Place bottoms and walls of pits and trenches monolithically.
- B. Concrete Walks: Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet, unless otherwise indicated. Cut contraction joints 3/4-inch deep with a jointing tool after the surface has been finished. Provide 1/2-inch thick transverse expansion joints at changes in direction, where sidewalk abuts curb, steps, rigid pavement, or other similar structures. Provide a transverse slope of 1/4-inch per foot and limit variation in cross section to 1/4-inch in 5 feet unless otherwise indicated.
- C. Curbs and Gutters: Provide contraction joints spaced every 10 feet maximum, unless otherwise indicated. Cut contraction joints 3/4-inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2-inch thick and spaced every 100 feet maximum, unless otherwise indicated. Provide a broom finish.
- D. Equipment Bases: Unless otherwise shown, all equipment shall be erected on bases of Class "B" concrete. Thickness shall be as noted on the Plans, but at no time shall it measure less than 1 inch.

- E. Concrete Stairs, Steps and Platforms: Stairs, steps and platforms shall be formed to required profiles shown on the Plans. Place reinforcing as required. Finish of stairs and steps shall be monolithic. Where shown on Plans, provide for nosings. Exterior stairs, steps and platforms shall have a non-slip finish. Before final troweling, embed abrasive grits, as specified in Paragraph 2.1, in the surface.

END OF SECTION

## SECTION 04 20 00

### UNIT MASONRY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout materials.
3. Mortar and grout mixes.

###### B. Products Installed but not Furnished under This Section:

1. Steel lintels in unit masonry.

##### 1.2 DEFINITIONS

###### A. CMU(s): Concrete masonry unit(s).

###### B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

##### 1.3 ACTION SUBMITTALS

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

###### B. Shop Drawings: For the following:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R.

###### Samples for Initial Selection:

3. Decorative CMUs, in the form of small-scale units.
4. Colored mortar.

##### 1.4 INFORMATIONAL SUBMITTALS

###### A. Material Certificates: For each type of the following:

1. Masonry units.
  - a. Include data on material properties.

- b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
  - 2. Integral water repellent used in CMUs.
  - 3. Mortar admixtures.
  - 4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  - 5. Grout mixes. Include description of type and proportions of ingredients.
  - 6. Reinforcing bars.
  - 7. Joint reinforcement.
  - 8. Anchors, ties, and metal accessories.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
- 1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
  - 2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.
- C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602.
- D. Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## 1.5 QUALITY ASSURANCE

- A. Qualifications:
- 1. Installers: All masonry flashing installers must complete the International Masonry Institute Flashing Upgrade training course.

## 1.6 DELIVERY, STORAGE, AND HANDLING

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

- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.7 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
  - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

## PART 2 - PRODUCTS

### 2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
  - 1. Where fire-resistance-rated construction is indicated, use the equivalent thickness method for masonry units in accordance with ACI 216.1 units are listed by UL or a qualified testing agency acceptable to authorities having jurisdiction.

## 2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  - 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units .
  - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested in accordance with ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, will show no visible water or leaks on the back of test specimen.
- C. Decorative CMUs: ASTM C90, normal weight.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2650 psi.
  - 2. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph above.
  - 3. Pattern and Texture: To match existing.
  - 4. Colors: To match existing.

## 2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- B. Masonry Cement: ASTM C91/C91M.
- C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
- D. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
- E. Water: Potable.

## 2.4 MORTAR AND GROUT MIXES

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

3. For exterior masonry, use Portland cement-lime masonry cement or mortar cement mortar.
  4. For reinforced masonry, use Portland cement-lime masonry cement or mortar cement mortar.
  5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in 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 C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For exterior, above-grade, load-bearing, nonload-bearing walls, and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
  2. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
1. Pigments do not exceed 10 percent of Portland cement by weight.
  2. Pigments do not exceed 5 percent of masonry cement or mortar cement by weight.
  3. Mix to match existing masonry.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
1. Mix to match Architect's sample.
  2. Application: Use colored-aggregate mortar for exposed mortar joints with all masonry units
- F. Grout for Unit Masonry: Comply with ASTM C476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
  2. Proportion grout in accordance with ASTM C476, paragraph 4.2.1.2 for specified 28-day compressive strength indicated, but not less than 2500 psi.
  3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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



1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
  2. Verify that foundations are within tolerances specified.
  3. Verify that reinforcing dowels are properly placed.
  4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

### 3.3 TOLERANCES

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

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

### 3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel 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, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay CMUs as follows:
  - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
  - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
  - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
  - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
  - 5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Lay structural clay tile as follows:
  - 1. Lay vertical-cell units with full head joints unless otherwise indicated. Provide bed joints with full mortar coverage on face shells and webs.
  - 2. Lay horizontal-cell units with full bed joints unless otherwise indicated. Keep drainage channels, if any, free of mortar. Form head joints with sufficient mortar so excess will be squeezed out as units are placed in position. Butter both sides of units to be placed, or butter one side of unit already in place and one side of unit to be placed.
  - 3. Maintain joint thicknesses indicated except for minor variations required to maintain bond alignment. If not indicated, lay walls with 1/4- to 3/8-inch- thick joints.
- D. Set firebox brick in full bed of refractory mortar with full head joints. Form joints by buttering both surfaces of adjoining brick and sliding it into place. Make joints just wide enough to accommodate variations in size of brick, approximately 1/8 inch. Tool joints smooth on surfaces exposed to fire or smoke.
- E. Install clay flue liners to comply with ASTM C1283. Install flue liners ahead of surrounding masonry. Set clay flue liners in full bed of refractory mortar 1/16 to 1/8 inch thick. Strike joints flush on inside of flue to provide smooth surface. Maintain expansion space between flue liner and surrounding masonry except where surrounding masonry is required to provide lateral support for flue liners.

- F. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.
- G. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
  - 1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.
- H. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- I. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

### 3.6 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
  - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
  - 2. Install preformed control-joint gaskets designed to fit standard sash block.
  - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
  - 4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.
- C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 "Joint Sealants," but not less than 3/8 inch.
  - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.
- D. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- E. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.

### 3.7 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  - 1. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  - 2. Limit height of vertical grout pours to not more than 60 inches.

### 3.8 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. 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, where indicated.
- 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. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

### 3.9 MASONRY WASTE DISPOSAL

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

END OF SECTION

## SECTION 05 50 00

### METAL FABRICATIONS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Miscellaneous framing and supports.

###### B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

###### C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.

##### 1.2 COORDINATION

- ###### A.
- Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

- ###### B.
- Coordinate installation of metal fabrications that are anchored to or that receive other work. 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.

##### 1.3 ACTION SUBMITTALS

###### A. Product Data:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Fasteners.
3. Shop primers.
4. Shrinkage-resisting grout.

- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
  - 1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
  - 2. Loose steel lintels.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Research Reports: For post-installed anchors.
- E. Delegated design engineer qualifications.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

#### 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

### 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, ambient; 180 deg F, material surfaces.



## 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

## 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

- I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

## 2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 09 91 23 "Interior Painting."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer that contains pigments that make it easily distinguishable from zinc-rich primer.
- C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- H. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the 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.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.

- E. Weld corners and seams continuously to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
1. Fabricate units from slotted channel framing where indicated.
  2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

## 2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
1. Provide mitered and welded units at corners.

2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles located in exterior walls.
- D. Prime shelf angles located in exterior walls with zinc-rich primer.
- E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

## 2.8 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize bearing and leveling plates.
- C. Prime plates with zinc-rich primer.

## 2.9 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

## 2.10 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

## 2.11 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

## 2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with primers specified in Section 09 91 23 "Interior Painting" unless indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
  - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
  - 5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. 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.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.

### 3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor shelf angles securely to existing construction with expansion anchors.

### 3.3 INSTALLATION OF SHELF ANGLES

- A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.

### 3.4 REPAIRS

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
  - 2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 23 "Interior Painting."

- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

SECTION 06 10 00  
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood blocking and nailers.
2. Wood furring

1.2 Section 06 20 23 "Interior Finish Carpentry".

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. OSB: Oriented strand board.
- E. Timber: Lumber of 5 inches nominal size or greater in least dimension.
- F. Lumber grading agencies, and abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
  2. NLGA: National Lumber Grades Authority.
  3. SPIB: The Southern Pine Inspection Bureau.
  4. WCLIB: West Coast Lumber Inspection Bureau.
  5. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include



physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

## 1.5 INFORMATIONAL SUBMITTALS

### A. Material Certificates:

1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

### B. Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Power-driven fasteners.
3. Post-installed anchors.
4. Metal framing anchors.
5. Sill sealer gasket/termite barrier.

## 1.6 QUALITY ASSURANCE

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  1. Factory mark each piece of lumber with grade stamp of grading agency.
  2. For exposed lumber indicated to receive a stained or natural finish, .
  3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
  4. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber:

1. Boards: 19 percent.
2. Dimension Lumber: 19 percent unless otherwise indicated.
3. Timber: 19 percent.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, are to meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

## 2.2 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.

B. Dimension Lumber Items: Standard, Stud, or No. 3 grade lumber of the following species:

1. Mixed southern pine or southern pine; SPIB.

C. Concealed Boards: 19 percent maximum moisture content and the following species and grades:

1. Mixed southern pine or southern pine; No. 3 grade; SPIB.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

## 2.3 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329 of Type 304 stainless steel.

2. For pressure-preservative-treated wood, use stainless steel fasteners.
  3. For redwood, use fasteners.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on as appropriate for the substrate.

## 2.4 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. MiTek Industries, Inc.
  2. Tamlyn.
- B. Allowable design loads, as published by manufacturer, are to meet or exceed those of products of manufacturers listed. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
1. Use for wood-preservative-treated lumber and where indicated.
- E. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, .
1. Use for exterior locations and where indicated.
- F. Bridging: Rigid, V-section, nailless type, 0.050 inch thick, length to suit joist size and spacing.

## 2.5 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- F. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
  - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
  - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
  - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
  - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.
- G. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- H. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.

- I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
  - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
  - 3. ICC-ES evaluation report for fastener.
- K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- L. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
  - 1. Comply with indicated fastener patterns where applicable.
  - 2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
  - 3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

### 3.2 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

## SECTION 06 20 23

### INTERIOR FINISH CARPENTRY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
2. Section 09 91 23 "Interior Painting" for priming and backpriming of interior finish carpentry.

##### 1.2 DEFINITIONS

##### 1.3 ACTION SUBMITTALS

###### A. Product Data:

1. Shelving and clothes rods.

###### B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

###### C. Samples: For each exposed product and for each color and texture specified.

##### 1.4 QUALITY ASSURANCE

##### 1.5 DELIVERY, STORAGE, AND HANDLING

###### A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.

1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
2. Provide for air circulation around stacks and under coverings.

- B. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

## 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet-work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
  - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. For exposed lumber, mark grade stamp on end or back of each piece , or omit grade stamp and provide certificates of grade compliance issued by grading agency.
- B. Softwood Plywood: DOC PS 1.
- C. Hardboard: ANSI A135.4.

### 2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC1 UC2.
  - 1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 18 percent, respectively.
  - 2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
  - 3. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
  - 4. Do not use material that is warped or does not comply with requirements for untreated material.

5. Mark lumber with treatment-quality mark of an inspection agency approved by the ALSC's Board of Review.
  - a. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
6. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
  - a. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.
7. Application: Where indicated on Drawings .

## 2.3 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
- C. Paneling Adhesive: Comply with paneling manufacturer's written instructions for adhesives.
- D. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

## 2.4 FABRICATION

- A. Back out or kerf backs of the following members, except those with ends exposed in finished work:
  1. Interior standing and running trim, except shoe and crown molds.
  2. Wood-board paneling.
- B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

### 3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.
  - 1. Use concealed shims where necessary for alignment.
  - 2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
  - 3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
  - 4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
  - 5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

### 3.4 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements.
  - 1. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.
- B. Adjust joinery for uniform appearance.

### 3.5 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces.
- B. Restore damaged or soiled areas and touch up factory-applied finishes if any.

### 3.6 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.

- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 07 21 00  
THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber blanket insulation.

B. Related Requirements:

1. Section 04 20 00 "Unit Masonry" for insulation installed in masonry cells.
2. Sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Glass-fiber blanket insulation.

1.3 INFORMATIONAL SUBMITTALS

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

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 PERFORMANCE REQUIREMENTS

- A. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

### 2.2 GLASS-FIBER BLANKET INSULATION

- A. Glass-Fiber Blanket Insulation, Unfaced : ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
  - 1. CertainTeed CertaPro Sustainable Insulation.
  - 2. Owens Corning Pink Next Gen Fiberglas Insulation.
  - 3. An Approved Equal.

### 2.3 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
  - 1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.

## 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. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

### 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 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, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
  5. For wood-framed construction, install blankets in accordance with ASTM C1320 and as follows:
    - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
  6. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
    - a. Exterior Walls: Set units with facing placed toward .
    - b. Interior Walls: Set units with facing placed .
- 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..
- C. Loose-Fill Insulation: Apply in accordance with ASTM C1015 and manufacturer's written instructions.
1. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
  2. For cellulosic-fiber loose-fill insulation, comply with CIMA's Bulletin #2, "Standard Practice for Installing Cellulose Insulation."
- D. Spray-Applied Cellulosic Insulation: Apply spray-applied insulation according to manufacturer's written instructions.
1. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked.
  2. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

### 3.4 INSTALLATION OF REFLECTIVE INSULATION

- A. Install sheet reflective insulation in accordance with ASTM C727.
- B. Install sheet radiant barriers in accordance with ASTM C1744.
- C. Install interior radiation control coating system in accordance with ASTM C1321.

### 3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. 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 92 00

### JOINT SEALANTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Silicone joint sealants.

##### 1.2 ACTION SUBMITTALS

###### A. Product Data:

1. Silicone joint sealants.

##### 1.3 INFORMATIONAL SUBMITTALS

###### A. Sample warranties.

##### 1.4 CLOSEOUT SUBMITTALS

##### 1.5 QUALITY ASSURANCE

##### 1.6 FIELD CONDITIONS

###### A. Do not proceed with installation of joint sealants under the following conditions:

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

##### 1.7 WARRANTY

###### A. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 JOINT SEALANTS, 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. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### 2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 35, NT: Single-component, nonsag, plus 35 percent and minus 35 percent movement capability. nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 35, Use NT.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adfast.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.
    - c. Premier Building Solutions.
    - d. The Dow Chemical Company.

### 2.3 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adfast.
    - b. Alcot Plastics Ltd.
    - c. Construction Foam Products; a division of Nomaco, Inc.
    - d. Master Builders Solutions; brand of MBCC Group.

### 2.4 MISCELLANEOUS MATERIALS

- A. 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.



## 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 performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Porcelain enamel.
    - b. Glazed surfaces of ceramic tile.

### 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 C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
  2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
  2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
  4. Provide flush joint profile at locations indicated on Drawings in accordance with Figure 8B in ASTM C1193.
  5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings in accordance with Figure 8C in ASTM C1193.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

### 3.4 CLEANING

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

### 3.5 PROTECTION

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

END OF SECTION

## SECTION 08 11 13

### HOLLOW METAL DOORS AND FRAMES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Interior standard steel doors and frames.

###### B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

##### 1.2 DEFINITIONS

- ###### A. Minimum Thickness:
- Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

##### 1.3 COORDINATION

- ###### A. Coordinate anchorage installation for hollow-metal frames.
- Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- ###### B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

##### 1.4 ACTION SUBMITTALS

###### A. Product Data:

1. Interior standard steel doors and frames.

###### B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, core descriptions, and finishes.

###### C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.

5. Details of each different wall opening condition.
  6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
  7. Details of anchorages, joints, field splices, and connections.
  8. Details of accessories.
  9. Details of moldings, removable stops, and glazing.
- D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.

## 1.6 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

## 1.7 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

## PART 2 - PRODUCTS

### 2.1 HOLLOW METAL DOORS AND FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ceco Door; AADG, Inc.; ASSA ABLOY.
  - 2. DCI Hollow Metal on Demand.
  - 3. DKS Steel Door & Frame Systems, Inc.
  - 4. Mesker Door; Mesker Openings Group.
  - 5. Steelcraft; Allegion plc.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
  - 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

### 2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule on Drawings.
  - 1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule on Drawings.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
    - d. Edge Construction: Model 1, Full Flush.
    - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
    - f. Core: Manufacturer's standard.
    - g. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.
  - 2. Frames:
    - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
    - b. Construction: Knocked down.
  - 3. Exposed Finish: Prime.

## 2.4 HOLLOW-METAL PANELS

- A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

## 2.5 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
  - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
  - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

## 2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

## 2.7 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
  - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
  - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

## 2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11 NAAMM-HMMA 840.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    - b. Install frames with removable stops located on secure side of opening.
  - 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
  - 3. Floor Anchors: Secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  - 4. Solidly pack mineral-fiber insulation inside frames.
  - 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
  - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  - 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
  - 1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8 NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.
  - 2. Fire-Rated Door: Install doors with clearances in accordance with NFPA 80.
  - 3. Smoke-Control Doors: Install doors in accordance with NFPA 105.

### 3.3 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.



- C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish in accordance with manufacturer's written instructions.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

## SECTION 08 71 11

### DOOR HARDWARE (DESCRIPTIVE SPECIFICATION)

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Hinges.
2. Mortise locks.
3. Mortise auxiliary locks.
4. Push-button combination locks.
5. Lock cylinders.
6. Key control cabinet.
7. Thresholds.
8. Metal protective trim units.

###### B. Related Requirements:

1. Section 08 11 13 "Hollow Metal Doors and Frames" for door silencers provided as part of hollow-metal frames.

##### 1.2 COORDINATION

###### A. Floor-Recessed Door Hardware: Coordinate layout and installation with floor construction.

1. Cast anchoring inserts into concrete.

###### B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

###### C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

###### D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

###### E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field-verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

### 1.3 PREINSTALLATION MEETINGS

### 1.4 ACTION SUBMITTALS

#### A. Product Data:

1. Hinges.
2. Mortise locks.
3. Mortise auxiliary locks.
4. Push-button combination locks.
5. Lock cylinders.
6. Key control cabinet.
7. Thresholds.
8. Metal protective trim units.
9. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

#### B. Product Data Submittals: For each product.

#### C. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule after or concurrent with submissions of product data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:
  - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
  - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
  - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
  - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
  - e. Fastenings and other installation information.
  - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
  - g. Mounting locations for door hardware.
  - h. List of related door devices specified in other Sections for each door and frame.

#### D. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final schedule.

## 1.7 QUALITY ASSURANCE

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lockup for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including excessive deflection, cracking, or breakage.
    - b. Faulty operation of doors and door hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
    - a. Electromagnetic and Delayed-Egress Locks: Five years from date of Substantial Completion.
    - b. Exit Devices: Two years from date of Substantial Completion.
    - c. Manual Closers: 10 years from date of Substantial Completion.
    - d. Concealed Floor Closers: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain each type of door hardware from single manufacturer.
  - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- C. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design" ICC A117.1.
  - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
  - 2. Comply with the following maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
    - b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
    - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
  - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
  - 4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
  - 5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

### 2.3 HINGES

- A. Hinges: ANSI/BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allegion plc.
    - b. Hager Companies.
    - c. McKinney Products Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
    - d. STANLEY; dormakaba USA, Inc.

B. Plain-Bearing Hinges: Grade 3 (standard weight).

1. Mounting: Full mortise (butts).
2. Base and Pin Metal: Steel with steel pin.
3. Pins: Nonrising loose unless otherwise indicated.
  - a. Outswinging Corridor Doors with Locks:
4. Tips: Flat button.
5. Corners: Square.
6. Features.

2.4 CENTER-HUNG AND OFFSET PIVOTS

A. Center-Hung and Offset Pivots: ANSI/BHMA A156.4.

1. Manufacturers: Subject to compliance with requirements, undefined:
  - a. Allegion plc.
  - b. dormakaba USA Inc.
  - c. Hager Companies.

2.5 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch latchbolt throw.
3. Deadbolts: Minimum bolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

1. Description:
2. Levers: Cast.
  - a. Construction: Solid
3. Escutcheons (Roses): Cast.
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
- F. Mortise Locks: ANSI/BHMA A156.13, Operational Grade 1 Security Grade 1 ; stamped steel case with steel or brass parts; Series 1000.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allegion plc.
    - b. BEST Access Solutions, Inc.; dormakaba USA Inc.
    - c. dormakaba USA Inc.
    - d. Hager Companies.
    - e. SARGENT Manufacturing Company; ASSA ABLOY.
    - f. STANLEY; dormakaba USA, Inc.
    - g. Yale Security Inc; ASSA ABLOY.

## 2.6 SURFACE BOLTS

## 2.7 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allegion plc.
    - b. ASSA, Inc.
    - c. BEST Access Solutions, Inc.; dormakaba USA Inc.
    - d. Hager Companies.
    - e. SARGENT Manufacturing Company; ASSA ABLOY.
    - f. STANLEY; dormakaba USA, Inc.
    - g. Yale Security Inc; ASSA ABLOY.
- B. Standard Lock Cylinders: ANSI/BHMA A156.5, Grade 1 permanent cores; face finished to match lockset.
  1. Core Type: Interchangeable Removable.
  2. Number of Pins: Six.
  3. Lock Type: Mortise type.

## 2.8 KEYING

- A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, appendix. Provide one extra key blank for each lock.
  1. Existing System:
    - a. Master key or grand master key locks to Owner's existing system.
    - b. Re-key Owner's existing master key system into new keying system.
  2. Keyed Alike: Key all cylinders to same change key.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
  - a. Notation: Information to be furnished by Owner.

## 2.9 THRESHOLDS

A. Thresholds: ANSI/BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Hager Companies.
  - b. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
  - c. Rixson Specialty Door Controls; ASSA ABLOY.

B. Saddle Thresholds:

1. Type: Smooth top.
2. Base Metal: Aluminum.

## 2.10 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: ANSI/BHMA A156.6; fabricated from 0.050-inch- thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Allegion plc.
  - b. Hager Companies.
  - c. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY.
  - d. Trimco.

B. Kick Plates: 10 inches high by door width with allowance for frame stops.

## 2.11 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and ANSI/BHMA A156.18.



- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended; however, aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
  - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
  - 2. Fire-Rated Applications:
    - a. Wood or Machine Screws: For the following:
      - 1) Hinges mortised to doors or frames.
      - 2) Strike plates to frames.
      - 3) Closers to doors and frames.
    - b. Steel Through Bolts: For the following unless door blocking is provided:
      - 1) Surface hinges to doors.
      - 2) Closers to doors and frames.
      - 3) Surface-mounted exit devices.
  - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
  - 4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

## 2.12 FINISHES

- A. Provide finishes complying with ANSI/BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. 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 the 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

### 3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.

### 3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Custom Steel Doors and Frames: HMMA 831.
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
  - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
  - 1. Replace construction cores with permanent cores as directed by Owner.
  - 2. Furnish permanent cores to Owner for installation.
- F. Key Control System:
  - 1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 07 92 00 "Joint Sealants."

- H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
  - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

### 3.4 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

### 3.5 DOOR HARDWARE SCHEDULE

- A. Hardware sets should be provided as specified below, or approved equal.  
Finishes to be selected by Owner from manufacturer's full range of finish options.

#### HW-1 (Single Dummy Trim) Single Hollow Metal Door

3 Hinge	Best Hvy Wt (.180), FBB168 4 ½" x 4 ½"
1 Dummy Trim (Pull Side)	Best 9K3-0-1DT-15D
1 Push Plate	Rockwood 70C-RKW
3 Silencer	Rockwood 608-RKW
1 Kickplate	Rockwood K1050
1 Each Wall Stops	DCI Concave Wall Mounted Door Stop

#### HW-2 (Privacy) Single Hollow Metal Door

3 Hinge	Best Hvy Wt(.180), FBB168 4 ½" x 4 ½"
1 Lockset	9K Series Commercial Grade Door Lock Mortise Lever #15D ADA Compliant (Best Access Brand)
1 Dummy Trim (Pull Side)	Best 9K3-0-1DT-15D
3 Silencer	Rockwood 608-RKW
1 Each Wall Stops	DCI Concave Wall Mounted Door Stop

HW-3 (Classroom) Single Hollow Metal Door

3 Hinge	Best Hvy Wt (.180), FBB168 4 ½” x 4 ½”
1 Lockset	9K Series Commercial Grade Classroom (AB) F109 Lever #15D ADA Compliant (Best Access Brand)
1 Kick Down Door Stop	Rockwood 460 – Kick Down Door Stop (Assa Abloy)
1 Set Weatherstripping	Head, Jambs and Sill (Pemko Brand)
1 Kickplate	Rockwood K1050

END OF SECTION

## SECTION 09 21 16.23

### GYPSUM BOARD SHAFT WALL ASSEMBLIES

#### 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. Gypsum board shaft wall assemblies.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.

##### 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 support them on risers on a flat platform to prevent sagging.

##### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.
- B. Do not install finish panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and 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 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E90 and classified according to ASTM E413 by a testing and inspecting agency.

### 2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated on Drawings.
- B. STC Rating: 51, minimum.
- C. Gypsum Shaftliner Board:
  - 1. Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch thick, with double beveled long edges.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) American Gypsum.
      - 2) CertainTeed; SAINT-GOBAIN.
      - 3) USG Corporation.
  - 2. Moisture- and Mold-Resistant Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D3273 mold-resistance score of 10 as rated according to ASTM D3274, 1 inch thick, and with double beveled long edges.
    - a. Manufacturers: Subject to compliance with requirements, undefined:
      - 1) American Gypsum.
      - 2) CertainTeed; SAINT-GOBAIN.
      - 3) USG Corporation.
  - 3. Moisture- and Mold-Resistant, Fiberglass-Mat Faced: ASTM C1658/C1658M; manufacturer's proprietary fire-resistive liner panels with ASTM D3273 mold-resistance score of 10 as rated according to ASTM D3274, 1 inch thick, and with double beveled long edges.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) American Gypsum.
      - 2) CertainTeed; SAINT-GOBAIN.
      - 3) USG Corporation.
- D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.

1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A653/A653M, G40 unless otherwise indicated.
- E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
  1. Depth: As indicated.
  2. Minimum Base-Metal Thickness: 0.030 inch.
- F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
  1. Minimum Base-Metal Thickness: Matching steel studs.
- G. Cementitious backer units as specified in Section 09 30 13 "Ceramic Tiling."
- H. Sound Attenuation Blankets: As specified in Section 07 21 00 Thermal Insulation."

## 2.3 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

## 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. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.

- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
  - 1. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
- F. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.3 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, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and 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 22 16

### NON-STRUCTURAL METAL FRAMING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Framing systems.
2. Grid suspension systems.

##### 1.2 ACTION SUBMITTALS

###### A. Product Data:

1. Framing systems.
2. Grid suspension systems.

##### 1.3 INFORMATIONAL SUBMITTALS

###### A. 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 Steel Framing Industry Association the Steel Stud Manufacturers Association or the Supreme Steel Framing System Association.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installation.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

## 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, in accordance with ASTM E119 by an independent testing agency.
- B. Horizontal Deflection: For non-composite wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft.
- C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.
- D. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. minimum as required by the IBC.
- E. Design framing systems to accommodate deflection of primary building structure and construction tolerances and to withstand design loads.

### 2.2 FRAMING SYSTEMS

- A. Studs and Track: AISI S220.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CEMCO; California Expanded Metal Products Co.
    - b. ClarkDietrich.
    - c. Steel Network, Inc. (The).
  - 2. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
  - 3. Depth: 3-5/8 inches.
- B. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CEMCO; California Expanded Metal Products Co.
    - b. ClarkDietrich.
    - c. Steel Network, Inc. (The).

## 2.3 GRID SUSPENSION SYSTEMS

- A. Grid Suspension Systems for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
  - 1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Armstrong Ceiling & Wall Solutions.
    - b. CertainTeed; SAINT-GOBAIN.
    - c. USG Corporation.

## 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 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
  - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
  - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
  - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.

2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
  3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
  4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 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.

### 3.4 INSTALLATION OF FRAMING SYSTEMS

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  1. Single-Layer Application: As required by horizontal deflection performance requirements 16 inches o.c. unless otherwise indicated.
  2. Tile Backing Panels: As required by horizontal deflection performance requirements 16 inches 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. 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.
  2. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  3. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

- 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 o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.5 INSTALLATION OF GRID SUSPENSION SYSTEMS

- A. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

END OF SECTION

## SECTION 09 30 13

### CERAMIC TILING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Porcelain tile.
2. Ceramic mosaic tile.
3. Tile backing panels.
4. Waterproof membranes.
5. Crack isolation membranes.
6. Setting material.

###### B. Related Requirements:

1. Section 07 92 00 "Joint Sealants" for sealing of movement joints in tile surfaces.

##### 1.2 DEFINITIONS

- A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Face Size: Actual tile size, excluding spacer lugs.
- C. Large Format Tile: Tile with at least one edge 15 inches or longer.
- D. Module Size: Actual tile size plus joint width indicated.

##### 1.3 ACTION SUBMITTALS

###### A. Product Data:

1. Porcelain tile.
2. Ceramic mosaic tile.
3. Tile backing panels.
4. Waterproof membranes.
5. Setting material.

###### B. Shop Drawings: Show locations, plans, and elevations, of each type of tile and tile pattern. Show widths, details, and locations of movement joints in tile substrates and finished tile surfaces.

###### C. Samples for Initial Selection: For tile, grout, and accessories involving color selection or shade variation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of product, including product use classification.
- C. Product Test Reports:
  - 1. Tile-setting and -grouting products.
  - 2. Certified porcelain tile.
  - 3. Slip-resistance test reports from qualified independent testing agency.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
  - 2. Installer's supervisor for Project holds the International Masonry Institute's Supervisor Certification.
  - 3. Installer employs only Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.
  - 4. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of mud floors mud walls membranes shower receptors and large format tile.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

#### 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in "Referenced Standards" Article in the Evaluations and manufacturer's written instructions.

## 1.8 WARRANTY

- A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.

- 1. Warranty Period: 10 years from date of Product Purchase.

## PART 2 - PRODUCTS

### 2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
  - 1. Provide tile complying with Standard Grade requirements.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
  - 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

### 2.2 PORCELAIN TILE

- A. Porcelain Tile Type CT-1: Unglazed.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Caesar Ceramics USA Run Porcelain Tile, or approved equal.
  - 2. Certification: Tile certified by the Porcelain Tile Certification Agency.
  - 3. Face Size: 12 by 24 inches.
  - 4. Face Size Variation: Rectified.
  - 5. Thickness: 3/8 inch.
  - 6. Product Use Classification: Interior, Wet (IW).
  - 7. Physical Properties: Chemical resistant when tested with indicated chemicals in accordance with ASTM C650.



- a. Unaffected.
- 8. Tile Color, Glaze, and Pattern: Tile color – Clay, Finish – Matte, Pattern – Staggered as shown on drawings
- 9. Grout Color: As selected by Architect from manufacturer's full range.
- 10. Precoat with temporary protective coating.
- 11. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
  - a. Base Cap: Surface bullnose, module size same as adjoining flat tile.
  - b. External Corners: Surface bullnose, module size same as adjoining flat tile.
  - c. Internal Corners: Field-buttet square corners.

B. Porcelain Tile Type CWT-1: Unglazed.

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Caesar Ceramics USA Run Porcelain Tile, or approved equal:
- 2. Certification: Tile certified by the Porcelain Tile Certification Agency.
- 3. Face Size: 12 by 24 inches.
- 4. Face Size Variation: Rectified.
- 5. Thickness: 3/8 inch.
- 6. Product Use Classification: Interior, Wet (IW).
- 7. Physical Properties: Chemical resistant when tested with indicated chemicals in accordance with ASTM C650.
  - a. Unaffected.
- 8. Tile Color, Glaze, and Pattern: Tile color – Clay, Finish – Matte, Pattern – Staggered as shown on drawings
- 9. Grout Color: As selected by Architect from manufacturer's full range.
- 10. Precoat with temporary protective coating.
- 11. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
  - a. Base Cap: Surface bullnose, module size same as adjoining flat tile.
  - b. External Corners: Surface bullnose, module size same as adjoining flat tile.
  - c. Internal Corners: Field-buttet square corners.

## 2.3 CERAMIC MOSAIC TILE

A. Ceramic Mosaic Tile Type CWT-2 : Unglazed.

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Caesar Ceramics USA Run Porcelain Tile, or approved equal:
- 2. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
- 3. Module Size: 2 by 2 inches on 12 by 12 inches sheet.
- 4. Thickness: 1/4 inch.
- 5. Face: Pattern of design indicated, with cushion edges.
- 6. Surface: Smooth, without abrasive admixture.
- 7. Product Use Classification: Interior, Wet (IW)
- 8. Physical Properties: Chemical resistant when tested with indicated chemicals in accordance with ASTM C650.
- 9. Tile Color and Pattern: Color – Road, Pattern as indicated on drawings.

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

#### 2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges in maximum lengths available to minimize end-to-end butt joints.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed; SAINT-GOBAIN.
    - b. James Hardie Building Products, Inc.
    - c. PermaBASE Building Products, LLC provided by National Gypsum Company.
    - d. USG Corporation.
  - 2. Thickness: 1/2 inch
  - 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

#### 2.5 WATERPROOF MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and ANSI A118.12 and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Waterproof Membrane, Fluid Applied: Liquid-latex rubber or elastomeric polymer.
  - 1. ARDEX 8+9 Rapid Waterproofing and Crack Isolation Compound
  - 2. Sika Tile Moisture Guard 100
  - 3. Laticrete 9235 Waterproofing Membrane
  - 4. An Approved Equal

#### 2.6 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
  - 1. Cleavage Membrane: Installer's option of material that complies with ANSI A108.02, paragraph 3.8.

#### 2.7 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

- B. Standard Cement Grout: ANSI A118.6.
  - 1. Laticrete Permacolor Grout
  - 2. An Approved Equal
- C. High-Performance Tile Grout: ANSI A118.7.
  - 1. Laticrete Permacolor Grout
  - 2. An Approved Equal
  - 3. Polymer Type:
    - a. Dry, redispersible form, prepackaged with other dry ingredients.
    - b. Liquid-latex form for addition to prepackaged dry-grout mix.
- D. Grout for PregROUTED Tile Sheets: Same product used in factory to pregROUT tile sheets.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  - 2. Verify that concrete substrates for tile floors installed with adhesives, bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
  - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
  - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.

- B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot toward drains.
- D. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- E. Substrate Flatness:
  - 1. For tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/16 inch in 12 inches when measured from tile surface high points.
  - 2. For large format tile, tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/16 inch in 24 inches when measured from tile surface high points.
- F. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

### 3.3 INSTALLATION OF CERAMIC TILE SYSTEM

- A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.
- B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
  - 1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.
- C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
  - 1. Allow crack isolation membrane to cure before installing tile or setting materials over it.
- D. Mix mortars and grouts to comply with "Referenced Standards" Article in the Evaluations and mortar and grout manufacturers' written instructions.
  - 1. Add materials, water, and additives in accurate proportions.
  - 2. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

- E. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.
1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
    - a. Exterior tile floors and walls.
    - b. Tile floors in wet areas.
    - c. Tile swimming pool decks.
    - d. Tile floors in laundries.
    - e. Tile floors consisting of tiles 8 by 8 inches or larger.
    - f. Tile floors consisting of rib-backed tiles.
  2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
  3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
  4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
  5. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
  6. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
    - a. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets, so joints between sheets are not apparent in finished Work.
    - b. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
    - c. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
  7. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- F. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.
1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- G. Metal Flooring Transitions: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- H. Metal Wall Trim: Install at locations indicated on Drawings.

### 3.4 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

### 3.5 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
  - 1. TCNA F125-Full CT-1: Thinset mortar on crack isolation membrane.
    - a. Ceramic Tile Type: Caesar Ceramics USA Run Porcelain Tile 12" x 24".
    - b. Thinset Mortar: mortar.
    - c. Grout: grout.
    - d. Crack Isolation Membrane: As recommended by setting material manufacturer.
    - e. Joint Width: 1/8 inch.
    - f. Movement Joints: Types located on Drawings.
- B. Interior Wall Installations, Wood or Metal Studs or Furring:
  - 1. TCNA W245 CWT-1: Thinset mortar on glass-mat, water-resistant gypsum backer board.
    - a. Ceramic Tile Type: Caesar Ceramics USA Run Porcelain Tile 12" x 24".
    - b. Thinset Mortar: Dry-set mortar.
    - c. Grout: Sand-portland cement grout.
    - d. Waterproof Membrane: As recommended by setting material manufacturer.
    - e. Joint Width: 1/8 inch.
    - f. Movement Joints: Types located on Drawings.
- C. Interior Wall Installations, Wood or Metal Studs or Furring:
  - 1. TCNA W245 CWT-1: Thinset mortar on glass-mat, water-resistant gypsum backer board.
    - a. Ceramic Tile Type: Caesar Ceramics USA Run Porcelain Tile 2" x 2" Mosaic.
    - b. Thinset Mortar: Dry-set mortar.
    - c. Grout: Sand-portland cement grout.
    - d. Waterproof Membrane: As recommended by setting material manufacturer.
    - e. Joint Width: 1/8 inch.
    - f. Movement Joints: Types located on Drawings.

END OF SECTION

## SECTION 09 51 23

### ACOUSTICAL TILE CEILINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Acoustical tiles.
2. Metal suspension system.
3. Metal edge moldings and trim.

###### B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

##### 1.2 ACTION SUBMITTALS

###### A. Product Data:

1. Acoustical tiles.
2. Metal edge moldings and trim.

###### B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

##### 1.3 INFORMATIONAL SUBMITTALS

###### A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
  - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical tile.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
  - a. Lighting fixtures.
  - b. Diffusers.
  - c. Grilles.
  - d. Speakers.
  - e. Sprinklers.
  - f. Access panels.
  - g. Perimeter moldings.

7. Show operation of hinged and sliding components adjacent to acoustical tiles.
8. Minimum Drawing Scale: 1/8 inch = 1 foot .

#### 1.4 CLOSEOUT SUBMITTALS

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

#### 1.5 QUALITY ASSURANCE

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical tiles, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

#### 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
  1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical tile ceiling installation.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.

#### 2.2 ACOUSTICAL TILES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Armstrong World Industries, Inc.
  2. CertainTeed; SAINT-GOBAIN.
  3. USG Corporation.



- B. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide tiles as follows:
  - 1. Type and Form, Type III: Mineral base with painted finish; Form 1, nodular .
  - 2. Pattern: CE (perforated, small holes and lightly textured).
- D. Color: As selected from manufacturer's full range.
- E. Light Reflectance (LR): Not less than 0.75.
- F. Noise Reduction Coefficient (NRC): Not less than 0.50.
- G. Edge/Joint Detail: Square, kerfed, and rabbeted; tongue and grooved; or butt As indicated by manufacturer's designation.
- H. Thickness: 5/8 inch Match existing ceiling tiles.
- I. Modular Size: 24 by 24 inches.
- J. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested in accordance with ASTM D3273, ASTM D3274, or ASTM G21 and evaluated in accordance with ASTM D3274 or ASTM G21.

## 2.3 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong Ceiling & Wall Solutions.
  - 2. USG Corporation.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, fully concealed, metal suspension system and accessories of type, structural classification, and finish indicated that complies with applicable requirements in ASTM C635/C635M.
  - 1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" in accordance with ASTM C635/C635M.

## 2.4 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed; SAINT-GOBAIN.
  - 3. Rockfon; ROCKWOOL International.
  - 4. USG Corporation.

- B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
  - 1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## 2.5 MISCELLANEOUS MATERIALS

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Testing Substrates: Before adhesively bonding tiles to wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's recommended limits.
- B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- C. Layout openings for penetrations centered on the penetrating items.

### 3.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

- A. Install suspended acoustical tile ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  8. Do not attach hangers to steel deck tabs.
  9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Arrange directionally patterned acoustical tiles as follows:
1. As indicated on reflected ceiling plans.
  2. Install tiles with pattern running in one direction parallel to long axis of space.
  3. Install tiles in a basket-weave pattern.

- G. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges of tiles so tile-to-tile joints are interlocked.
  - 1. Fit adjoining tiles to form flush, tight joints. Scribe and cut tiles for accurate fit at borders and around penetrations through ceiling.
  - 2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tiles and moldings, spaced 12 inches o.c.
  - 3. Protect lighting fixtures and air ducts in accordance with requirements indicated for fire-resistance-rated assembly.

### 3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet , non-cumulative.
- B. Directly Attached Ceilings: Install bottom surface of tiles to a tolerance of 1/8 inch in 12 feet and not exceeding 1/4 inch cumulatively.
- C. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

### 3.5 ADJUSTING

- A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

## SECTION 09 65 13

### RESILIENT BASE AND ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Vinyl base.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

##### 1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Coordinate mockups in this Section with mockups specified in other Sections.
  - 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.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

## 1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F , in spaces to receive resilient products during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F .
- C. Install resilient products after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

### 2.2 VINYL BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. Johnsonite; a Tarkett company.
  - 3. Roppe Corporation; Roppe Holding Company.
- B. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).
  - 1. Group: I (solid, homogeneous) .
  - 2. Style and Location:
    - a. Style B, Cove: Provide in areas with resilient floor coverings.
- C. Minimum Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.
- F. Outside Corners: Job formed or preformed.
- G. Inside Corners: Job formed or preformed.
- H. Colors and Patterns: As selected by Owner.

## 2.3 INSTALLATION MATERIALS

- A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
  - 4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Form without producing discoloration (whitening) at bends.
  2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Miter or cope corners to minimize open joints.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
  1. Tightly adhere to substrates throughout length of each piece.
  2. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.



### 3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum horizontal surfaces thoroughly.
  - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.
  - 1. Apply coat(s).
- E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

## SECTION 09 65 19

### RESILIENT TILE 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:
  - 1. Vinyl composition floor tile.

##### 1.3 ACTION SUBMITTALS

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

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

##### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

## 1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F , in spaces to receive floor tile during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F .
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

### 2.2 VINYL COMPOSITION FLOOR TILE LVT-1

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Interface Studio Set; or a comparable product by one of the following:
  - 1. Armstrong Flooring, Inc.
  - 2. Mohawk.
  - 3. Johnsonite; a Tarkett company.
  - 4. Shaw.
- B. Tile Standard: ASTM F 1066, Class 3, surface pattern.
- C. Wearing Surface: Embossed.
- D. Thickness: 0.177 inches.

- E. Size: 9.845 in x 39.38 in.
- F. Colors and Patterns: A00703 Pepper, as selected by Owner. Install in Ashlar pattern

## 2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
  - 4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

- b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

### 3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles in pattern indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

- I. Resilient Terrazzo Accessories: Install according to manufacturer's written instructions.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 09 91 23  
INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Primers.
- 2. Water-based finish coatings.
- 3. Solvent-based finish coatings.

B. Related Requirements:

- 1. Section 05 50 00 "Metal Fabrications" for shop priming metal fabrications.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

- 1. Include preparation requirements and application instructions.
- 2. Indicate VOC content.

- B. Samples for Initial Selection: For each type of topcoat product.

1.4 QUALITY ASSURANCE

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

- 1. Maintain containers in clean condition, free of foreign materials and residue.
- 2. Remove rags and waste from storage areas daily.

## 1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Behr Paint Company; Behr Process Corporation.
  - 2. Benjamin Moore & Co.
  - 3. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
  - 4. Sherwin-Williams Company (The).
- B. Source Limitations: Obtain each paint product from single source from single manufacturer.

### 2.2 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from manufacturer's full range.

### 2.3 PRIMERS

- A. Interior Latex Primer Sealer: Water-based latex sealer used on new interior plaster, concrete, and gypsum wallboard surfaces.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Behr Paint Company; Behr Process Corporation.
    - b. Benjamin Moore & Co.
    - c. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
    - d. Sherwin-Williams Company (The).



- B. Alkyd Quick-Dry Primer for Metal: Corrosion-resistant, solvent-based, modified-alkyd primer; lead and chromate free; formulated for quick-drying capabilities and for use on cleaned, interior steel surfaces.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Benjamin Moore & Co.
    - b. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
    - c. Sherwin-Williams Company (The).
- C. Anti-Corrosive Epoxy Primer: Corrosion-resistant, solvent-based, two-component epoxy primer formulated for use on prepared, interior ferrous- and galvanized-metal surfaces.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Benjamin Moore & Co.
    - b. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
    - c. Sherwin-Williams Company (The).

## 2.4 WATER-BASED FINISH COATS

- A. Interior, Latex, High-Performance Architectural Coating, Semigloss: High-performance architectural latex coating providing a significantly higher level of performance than conventional latex paints in the areas of scrub resistance, burnish resistance, and ease of stain removal.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Behr Paint Company; Behr Process Corporation.
    - b. Benjamin Moore & Co.
    - c. Sherwin-Williams Company (The).
  - 2. Gloss Level: Manufacturer's standard semigloss finish .

## 2.5 SOLVENT-BASED FINISH COATS

- A. Interior, Alkyd, Semigloss: Pigmented, solvent-based alkyd paint for use on primed/sealed interior plaster, gypsum, wood, and metal walls primarily in residential and moderate traffic commercial environments.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Behr Paint Company; Behr Process Corporation.
    - b. Benjamin Moore & Co.
    - c. Sherwin-Williams Company (The).
  - 2. Gloss Level: Manufacturer's standard semigloss finish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Fiber-Cement Board: 12 percent.
  - 3. Masonry (Clay and CMUs): 12 percent.
  - 4. Wood: 15 percent.
  - 5. Gypsum Board: 12 percent.
  - 6. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- G. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 2.
  - 2. SSPC-SP 3.
  - 3. SSPC-SP 7/NACE No. 4.
  - 4. SSPC-SP 11.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.
  - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

### 3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  1. Paint the following work where exposed in equipment rooms:
    - a. .
  2. Paint the following work where exposed in occupied spaces:
    - a. .
  3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
  1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
  2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
  3. Allow empty paint cans to dry before disposal.
  4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

B. Gypsum Board Substrates:

1. High-Performance Architectural Latex System PC-1:
  - a. Prime Coat: Interior latex primer sealer.
  - b. Intermediate Coat: Matching topcoat.
  - c. Topcoat: Interior, latex, high-performance architectural coating, semigloss.

END OF SECTION

## SECTION 10 28 00

### TOILET, BATH, AND LAUNDRY ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.

###### B. Related Requirements:

1. Section 09 30 13 "Ceramic Tiling" for ceramic toilet and bath accessories.

##### 1.2 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

##### 1.3 ACTION SUBMITTALS

###### A. Product Data:

1. Public-use washroom accessories.
2. Public-use shower room accessories.

###### B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

###### C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

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

#### 1.6 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, visible silver spoilage defects.
  - 2. Warranty Period: 15 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
  - 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
  - 2. Shower Seats: Installed units are able to resist 360 lbf concentrated load applied in any direction and at any point.

#### 2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Combination Toilet Tissue Dispenser 5:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AJW Architectural Products.
    - b. ASI-American Specialties, Inc.
    - c. Bobrick Washroom Equipment, Inc.
    - d. Bradley Corporation.
    - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

- f. Tubular Specialties Manufacturing, Inc.
- 2. Description: Combination unit with double-roll toilet tissue dispenser and the following:
  - a. Removable sanitary-napkin waste receptacle with self-closing, disposal-opening cover.
  - b. Seat-cover dispenser with minimum capacity of 500 single or half-fold seat covers.
- 3. Mounting: Partition mounted, dual access with two tissue rolls per compartment and with one side that mounts flush with partition of accessible compartment.
- 4. Toilet Tissue Dispenser Capacity: 4-1/2- or 5-inch- diameter tissue rolls.
- 5. Toilet Tissue Dispenser Operation: Noncontrol delivery with theft-resistant spindles.
- 6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin) .
- 7. Lockset: Tumbler type.

B. Paper Towel (Folded) Dispenser: 8

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
  - d. Brey-Krause Manufacturing Co.
  - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
  - f. Tubular Specialties Manufacturing, Inc.
- 2. Mounting: Recessed.
- 3. Minimum Capacity: 400 C-fold or 525 multifold towels.
- 4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- 5. Lockset: Tumbler type.
- 6. Refill Indicator: Pierced slots at sides or front.

C. Waste Receptacle: 8

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
  - d. Brey-Krause Manufacturing Co.
  - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
  - f. Tubular Specialties Manufacturing, Inc.
- 2. Mounting: Open top, recessed.
- 3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- 4. Liner: Reusable vinyl liner.
- 5. Lockset: Tumbler type for waste receptacle.

D. Warm-Air Hand Dryer: 9

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
  - d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.



- e. Tubular Specialties Manufacturing, Inc.
- 2. Description: Standard-speed, warm-air hand dryer.
- 3. Mounting: Surface mounted.
  - a. Protrusion Limit: Installed unit protrudes maximum 4 inches from wall surface.
- 4. Operation: Infrared-sensor activated with timed power cutoff switch.
  - a. Automatic Shutoff: At 40 seconds.
- 5. Maximum Sound Level: 63 dB.
- 6. Cover Material and Finish: Steel, with white enamel finish.
- 7. Electrical Requirements: 115 V, 13 A, 1500 W.

E. Automatic Soap Dispenser: 6

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. Bradley Corporation.
  - c. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
- 2. Description: Automatic dispenser with infrared sensor to detect presence of hands; electrically operated, with adapter for 110 to 240 V ac power supply ; designed for dispensing soap in liquid or lotion lather form.
- 3. Mounting: Deck mounted on lavatory.
- 4. Refill Indicator: LED indicator.
- 5. Low-Battery Indicator: LED indicator.

F. Grab Bar: 1, 2, 3 & 19

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
  - d. Brey-Krause Manufacturing Co.
  - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
  - f. Tubular Specialties Manufacturing, Inc.
- 2. Mounting: Flanges with concealed fasteners.
- 3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.
- 4. OD: 1-1/2 inches.
- 5. Configuration and Length: As indicated on Drawings .

G. Mirror Unit : 4

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
  - d. Brey-Krause Manufacturing Co.
  - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
  - f. Tubular Specialties Manufacturing, Inc.

2. Frame: Stainless steel, fixed tilt.
  - a. Corners: Manufacturer's standard.
3. Size: 16 x 30 inch.
4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

## 2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

### A. Shower Curtain Rod: 20

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
  - d. Brey-Krause Manufacturing Co.
  - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
  - f. Tubular Specialties Manufacturing, Inc.
2. Description: 1-inch- OD, straight rod.
3. Configuration: As indicated on Drawings.
4. Mounting Flanges: Concealed fasteners; in manufacturer's standard material and finish.
5. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin) Polished chrome-plated brass.

### B. Shower Curtain: 20

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
  - d. Brey-Krause Manufacturing Co.
  - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
  - f. Tubular Specialties Manufacturing, Inc.
2. Size: Minimum 6 inches wider than opening by 72 inches high.
3. Material: Nylon-reinforced vinyl, minimum 9 oz. or 0.008-inch- thick vinyl, with integral antibacterial and flame-retardant agents.
4. Color: As selected from manufacturer's full range.
5. Grommets: Corrosion resistant at minimum 6 inches o.c. through top hem.
6. Shower Curtain Hooks: Chrome-plated or stainless steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

### C. Folding Shower Seat: 18

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
  - d. Brey-Krause Manufacturing Co.

- e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
- f. Tubular Specialties Manufacturing, Inc.
- 2. Configuration: L-shaped seat, designed for wheelchair access.
- 3. Seat: Stainless steel, ASTM A480/A480M No. 4 finish (satin); 0.05-inch- minimum nominal thickness; with single-piece, pan-type construction and edge seams welded and ground smooth.
- 4. Mounting Mechanism: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

D. Robe Hook:10

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
  - d. Brey-Krause Manufacturing Co.
  - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
  - f. Tubular Specialties Manufacturing, Inc.
- 2. Description: Double -prong unit.
- 3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

## 2.4 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

## 2.5 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
  - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

### 3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION

## SECTION 10 44 00

### FIRE EXTINGUISHERS

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Fire Extinguishers, as shown of the Plans, as specified and/or directed.

##### 1.02 REFERENCES

- A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. The following is a list of standards which may be referenced in this Section:
  - 1. Factory Mutual (FM).
  - 2. Mine Safety and Health Administration (MSHA).
  - 3. National Fire Protection Association:
  - 4. 10, Standard for Portable Fire Extinguishers.
  - 5. National Institute for Safety and Health (NIOSH): Certification Program.
  - 6. Occupational Safety and Health Act (OSHA).
  - 7. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment List.
  - 8. ASTM International: ASTM E814, Standard Test Method for Fire Tests of Penetration Firestop Systems.

##### 1.03 SUMMARY

- A. Section includes:
  - 1. Fire extinguishers.
  - 2. Brackets for wall mounting.
  - 3. Projecting graphic identification signage.
- B. Related work specified elsewhere:
  - 1. Section 06 10 01, Rough Carpentry.
  - 2. Section 09 91 00, Painting.

##### 1.04 SUBMITTALS

- A. Comply with General Conditions and provide the following:
  - 1. Action Submittals:
    - a. Fire Extinguishers: Submit manufacturer's product data for each item, including sizes, UL listings, or other certifications and mounting information.

- b. Product Data: Submit extinguisher operational features, color and finish, and anchorage details.
- 2. Informational Submittals:
  - a. Manufacturer's Installation Instructions:
    - 1) Special criteria and wall opening coordination requirements.
  - b. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
  - c. Operation and Maintenance Data: Submit test, refill or recharge schedules and recertification requirements.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with General Conditions.
- B. Inspection: Accept materials on Site and inspect for damage.
- C. Store and protect materials according to manufacturer's instructions.
- D. Do not install extinguishers when ambient temperature is capable of freezing extinguisher contents.

### PART 2 - PRODUCTS

#### 2.01 FIRE EXTINGUISHERS

- A. Manufacturers:
  - 1. JL Industries
  - 2. Larsen's Manufacturing Company
  - 3. Nystrom Products Company
  - 4. Potter Roemer
  - 5. Or Approved Equal
- B. General:
  - 1. Conform to NFPA 10 for fire extinguishers.
  - 2. Furnish all fire extinguishers from one manufacturer.
  - 3. UL-listed, charged and ready for service.
  - 4. Provide two (2) 20-B (lb) fire extinguishers, with mounting bracket and graphic identification sign, as specified herein.
- C. Multi-Purpose Hand Extinguisher (EXT-1):
  - 1. Tri-class dry chemical extinguisher agent.
  - 2. Pressurized, red enamel steel shell cylinder.
  - 3. Activated by top squeeze handle.

4. Agent propelled through hose or opening at top of unit.
5. For use on A, B, and C class fires.
6. Minimum UL Rating: 4A:80B:C, 10-lb capacity.

## 2.02 ACCESSORIES

- A. Extinguisher Brackets: For each extinguisher, furnish heavy-duty brackets with clip-together strap for wall-mounting formed steel, white enamel finish.
- B. Graphic Identification Sign:
  1. Provide projecting graphic identification sign for each fire extinguisher furnished.
  2. Each sign shall use photo-luminescent material to remain illuminated during a power outage and shall comply with ASTM E2072.
  3. Sign shall include OSHA-approved pictorial markings to indicate the extinguisher uses and non-uses on a single label.
  4. Manufacturer: GlowSmart, or approved equal.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install where indicated or directed and in accordance with the manufacturer's recommendations.
- B. Install brackets and graphic identification signs plumb and level on walls.
- C. Install wall brackets maximum 48 inches from finished floor to top of extinguisher handle.
- D. Place extinguishers on wall brackets.

END OF SECTION

## SECTION 12 32 16

### MANUFACTURED PLASTIC-LAMINATE-CLAD CASEWORK

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Plastic-laminate-clad casework.
2. Hardware and accessories.

###### B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood blocking for anchoring casework.
2. Section 09 65 13 "Resilient Base and Accessories" for resilient base applied to plastic-laminate-clad casework.
3. Section 12 36 23.13 "Plastic-Laminate-Clad Countertops."

##### 1.2 DEFINITIONS

- ###### A. Definitions in the AWI/AWMAC/WT's "Architectural Woodwork Standards" apply to the Work of this Section.

##### 1.3 PREINSTALLATION MEETINGS

##### 1.4 COORDINATION

- ###### A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that casework can be supported and installed as indicated.

##### 1.5 ACTION SUBMITTALS

###### A. Product Data:

1. Plastic-laminate-clad casework.
2. Hardware and accessories.

###### B. Shop Drawings: For plastic-laminate-clad casework.

1. Include plans, elevations, sections, and attachments to other work including blocking and reinforcements required for installation.
2. Indicate types and sizes of casework.



3. Indicate manufacturer's catalog numbers for casework.
4. Show fabrication details, including types and locations of hardware.
5. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and equipment.
6. Apply AWI's Quality Certification WI's Certified Compliance Program label to Shop Drawings.

C. Samples: For casework and hardware finishes.

D. Samples for Initial Selection: For casework and hardware finishes.

## 1.6 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

## 1.7 CLOSEOUT SUBMITTALS

## 1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer and Licensed participate in AWI's Quality Certification Program Licensed participate in WI's Certified Compliance Program.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

## 1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during remainder of construction period. Maintain temperature and relative humidity during remainder of construction period in range recommended for Project location by the AWI/AWMAC/WI's "Architectural Woodwork Standards."

B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

C. Field Measurements: Where casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.

D. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing them, and indicate measurements on Shop Drawings.

## 1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Delamination of components or other failures of glue bond.
    - b. Warping of components.
    - c. Failure of operating hardware.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR CASEWORK

- A. Quality Standard: Unless otherwise indicated, comply with the AWI/AWMAC/WT's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.
  - 1. Grade: Economy.
  - 2. Provide labels and certificates from AWI WI certification program indicating that casework complies with requirements of grades specified.
    - a. This Project has been registered with AWI as AWI's Quality Certification Program Number.
    - b. Contractor to register the Work under this Section with AWI's Quality Certification Program at [www.awiqcp.org](http://www.awiqcp.org) or by calling 855-345-0991.
- B. Product Designations:
  - 1. Drawings indicate sizes, configurations, and finish materials of manufactured plastic-laminate-clad casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish materials, and complying with the Specifications may be considered. See Section 016000 "Product Requirements."
  - 2. Drawings indicate configurations of manufactured plastic-laminate-clad casework by referencing designations of Casework Design Series numbering system in the Appendix of the AWI/AWMAC/WT's "Architectural Woodwork Standards."

### 2.2 PLASTIC-LAMINATE-CLAD CASEWORK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Case Systems Inc.
  - 2. Stevens Industries, Inc.
  - 3. TMI Systems Corporation.
- B. Source Limitations: Obtain from single source from single manufacturer.

- C. Design: Face-frame cabinet construction with the following door and drawer-front style:
  - 1. Reveal overlay.
- D. Grain Direction for Wood-Grain Plastic Laminate:
  - 1. Doors: Vertical with continuous vertical matching.
  - 2. Drawer Fronts: Vertical with continuous vertical matching.
  - 3. Face Frame Members: Lengthwise.
  - 4. End Panels: Vertical.
  - 5. Bottoms and Tops of Units: Side to side.
  - 6. Knee Space Panels: Vertical.
  - 7. Aprons: Horizontal.
- E. Exposed Materials:
  - 1. Plastic-Laminate Grade: HGS.
    - a. Colors and Patterns: As selected by Owner.
  - 2. Edgebanding: Plastic laminate matching adjacent surfaces.
    - a. PVC Edgebanding Color: As selected by Owner.
- F. Semiexposed Materials:
  - 1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semiexposed surfaces unless otherwise indicated.
    - a. Colors and Patterns: As selected by Owner.
    - b. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.
  - 2. Unless otherwise indicated, provide specified edgebanding on all semiexposed edges.
- G. Concealed Materials:
  - 1. Plastic Laminate: Grade VGS.

## 2.3 HARDWARE AND ACCESSORIES

- A. Hardware: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.
  - 1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
- B. Butt Hinges: Stainless steel , semiconcealed, five-knuckle hinges complying with ANSI/BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two hinges for doors less than 48 inches high, and provide three hinges for doors more than 48 inches high.
- C. Wire Pulls: Solid stainless steel wire pulls, fastened from back with two screws.
  - 1. For sliding doors, provide recessed stainless steel flush pulls.
  - 2. Provide two pulls for drawers more than 24 inches wide.

- D. Door Catches: Zinc-plated Powder-coated, nylon-roller spring catch. Provide two catches on doors more than 48 inches high.
- E. Door and Drawer Bumpers: Self-adhering, clear silicone rubber.
  - 1. Doors: Provide one bumper at top and bottom of closing edge of each swinging door.
  - 2. Drawers: Provide one bumper on back side of drawer front at each corner.
- F. Sliding-Door Hardware Sets: Manufacturer's standard, to suit type and size of sliding-door unit.
  - 1. Pin-type, two-pin-locking plastic shelf rests complying with ANSI/BHMA A156.9, Type B04013.

## 2.4 MATERIALS

- A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
- B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.
- C. Softwood Plywood: DOC PS 1.
- D. Particleboard: ANSI A208.1, Grade M-2.
- E. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.
- F. Hardboard: ANSI A135.4, Class 1 tempered.
- G. Plastic Laminate: High-pressure decorative laminate complying with ISO 4586-3.
  - 1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Formica Corporation.
    - b. Laminart LLC.
    - c. Wilsonart LLC.
  - 2. Source Limitations: Obtain from single source from single manufacturer.
- H. PVC Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3.0 mm thick at doors and drawer fronts, 1.0 mm thick elsewhere.

## 2.5 FABRICATION

- A. Plastic-Laminate-Clad Cabinet Construction: As required by referenced quality standard, but not less than the following:
  - 1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch particleboard.
  - 2. Shelves: 3/4-inch- thick plywood or 1-inch- thick particleboard.
  - 3. Backs of Casework: 1/2-inch- thick particleboard or MDF where exposed, 1/4-inch- thick, veneer-core hardwood plywood dadoed into sides, bottoms, and tops where not exposed.
  - 4. Drawer Fronts: 3/4-inch particleboard.

5. Drawer Sides and Backs: 1/2-inch- thick solid-wood or veneer-core hardwood plywood , with glued dovetail or multiple-dowel joints.
  6. Drawer Bottoms: 1/4-inch- thick hardwood plywood glued and dadoed into front, back, and sides of drawers. Use 1/2-inch material for drawers more than 24 inches wide.
- B. Filler Strips: Provide as needed to close spaces between casework and walls, ceilings, and equipment. Fabricate from same material and with same finish as casework.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- A. Grade: Install casework to comply with same quality standard grade as item to be installed.
- B. Install casework level, plumb, and true in line; shim as required using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten cabinets to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch.
- E. Fasten casework to adjacent units and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI/AWMAC/WT's "Architectural Woodwork Standards."
- F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- G. Adjust operating hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

### 3.3 CLEANING

- 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.

END OF SECTION

SECTION 12 36 61.16  
SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials and sinks.

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 Initial Selection: For each type of material exposed to view.

1.3 INFORMATIONAL SUBMITTALS

A. 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 ISFA 2-01.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Wilsonart LLC; 051 or a comparable product by one of the following:
    - a. Affinity Surfaces; a brand of Domain Industries, Inc.
    - b. Avonite Surfaces.
    - c. E. I. du Pont de Nemours and Company.
    - d. Formica Corporation.
    - e. LG Chemical, Ltd.
    - f. Meganite Inc.
    - g. Samsung Chemical USA, Inc.
    - h. Swan Corporation (The).
    - i. Transolid Div of Trumbull Industries.
  - 1. Type: Provide Standard type unless Special Purpose type is indicated.
  - 2. Integral Sink Bowls: Comply with CSA B45.5/IAPMO Z124.
  - 3. Colors and Patterns: SS-1 – White Stone 9208CS with semigloss finish as selected by Architect from manufacturer's full range.

### 2.2 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: Economy.
- B. Countertops:
  - 1. 1/2-inch- thick, solid surface material with front edge built up with same material.
- C. Backsplashes: 3/4-inch- thick, solid surface material.



- D. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
  - 1. Install integral sink bowls in countertops in the shop.
- E. Cutouts and Holes:
  - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures **in the 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.
    - 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.
  - 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.
  - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

## 2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "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, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. 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. 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.
- D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
  - 1. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- 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 21 13 13

### WET-PIPE SPRINKLER SYSTEMS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Wet-Pipe Sprinkler Systems as shown on the Plans, as specified, and/or directed.

##### 1.02 REFERENCE STANDARDS

- A. The following is a list of standards that may be referenced in this section:
1. American Society for Testing and Materials (ASTM) Publication:
    - a. A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
    - b. A120 – Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses
  2. American Water Works Association, Inc. (AWWA) Publication:
    - a. C104 – Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water
    - b. C110 – Ductile-Iron and Gray-Iron Fittings, 3 inch Through 48 inch, for Water and Other Liquids
    - c. C151 – Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
    - d. C500 – Gate Valves, 3 inch Through 48 inch NPS, for Water and Sewage Systems
    - e. C601 – Disinfecting Water Mains
  3. Factory Mutual System (FM) Publication:
    - a. P7825 – Approval Guide
  4. Federal Specifications (FS) Publication:
    - a. TT-E-489 – Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces)
    - b. TT-P-645 – Primer, Paint, Zinc Chromate, Alkyd Type
  5. Military Specifications (MIL) Publication:
    - a. DOD-P-15328 – Primer (Wash), Pretreatment (Formula No. 117 for Metals) (Metric)
  6. National Fire Protection Association (NFPA) Publication:
    - a. 13 – Sprinkler Systems
    - b. 25 – Inspection, Testing and Maintenance of Water-Based Fire Protection Systems
    - c. 70 – National Electrical Code
    - d. 170 – Fire Safety and Emergency Symbols

- e. 291 – Recommended Practice for Fire Flow Testing and Marking of Hydrants
- 7. Underwriters Laboratory, Inc. (UL) Publication:
  - a. 262 – Gate Valves for Fire-Protection Service
  - b. 789 – Indicator Posts for Fire-Protection Service
  - c. FPED – Fire Protection Equipment Directory
- 8. Uniform Fire Prevention and Building Code of New York State Publication:
  - a. 2020 – Fire Code of New York State
- 9. Foundation for Cross Connection Control and Hydraulic Research, University of Southern California (FCCCHR) Publication:
  - a. List of Approved Backflow Prevention Assemblies (Obtain current date from NAVFAC HQ, Code 04)

### 1.03 QUALIFICATIONS OF INSTALLER

- A. Prior to installation, submit data for approval showing that the Contractor has successfully installed automatic fire extinguishing sprinkler systems of the same type and design as specified herein, or that Contractor has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. The Contractor shall indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

### 1.04 DESCRIPTION OF WORK

- A. The work includes modifying the existing automatic wet pipe fire extinguishing sprinkler systems for uniform distribution of water to afford complete fire protection coverage to protect spaces as indicated on Contract Drawings. The existing sprinkler heads shall be installed in the new ceiling grid and two new sprinkler heads provided in the new closet spaces. The design, equipment, materials, installation, workmanship, examination, inspection, and testing shall be in strict accordance with the required and advisory provisions of NFPA 13, except as modified herein. Each system shall include all materials, accessories, and equipment inside the building to provide each system complete and ready for use. Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ductwork, and other construction and equipment in accordance with detailed drawings to be submitted for approval. Locate sprinkler heads in a consistent pattern with ceiling grid, lights, and supply and return air diffusers and grilles. Devices and equipment for fire protection service shall be UL FPED listed or FM P7825 approved for use in wet pipe sprinkler systems. In the NFPA publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Engineer Division, Naval Facilities Engineering

Command, Fire Protection Engineer. The work shall begin at the points indicated.

#### 1.05 SUBMITTALS

- A. Manufacturer's Data:
  - 1. Pipe, fittings, and mechanical couplings
  - 2. Sprinkler heads
  - 3. Pipe hangers and supports
- B. Shop Drawings:
  - 1. Sprinkler heads and piping system layout
- C. Fabrication/Erection/Installation Drawings:
  - 1. Partial submittals will not be acceptable. Annotate descriptive data to show the specific model, type, and size of each item the Contractor proposes to provide. Prepare working drawings on sheets not smaller than 30 inches by 42 inches, in accordance with the requirements for "Working Drawings (Plans)" as specified in NFPA 13; include data for proper installation of each system. The Engineer, will review and approve submittals. Before any work is commenced, submit the design, manufacturer's data, and complete sets of working drawings for each system.
- D. Certificate of compliance:
  - 1. Contractor's material and test certificate
  - 2. Pipe and fittings
- E. Operation and Maintenance Manuals:
  - 1. After completion, but before final acceptance of the work, furnish a complete set of drawings of each system for record purposes. Drawings shall not be smaller than 30 inches by 42 inches drawings on mylar film with title block (8 inches by 4 inches) similar to full size Contract Drawings. Furnish the as built (record) working drawings in addition to the as built Contract Drawings required by Division 1, "General Requirements".

#### 1.06 ELECTRICAL WORK

- A. Provide electrical work associated with this section under Division 26, except for control and fire alarm wiring. Provide control and fire alarm wiring, including connections to fire alarm systems, under this section in accordance with NFPA 70 and Division 26. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be used in dry locations not enclosed in concrete or where not subject to mechanical damage.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Design of Sprinkler Systems: NFPA 13 and requirements specified herein.
- B. Water Distribution: Distribution shall be uniform throughout the area in which it is assumed the sprinkler heads will open. Variation in discharge from individual heads in the hydraulically most remote area shall be between 100 and 120 percent of the specified density.
- C. Density of Application of Water: Size pipe to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the sprinklers shall be 0.15 gpm per square foot.
- D. Sprinkler Discharge Area: Area shall be the hydraulically most remote 1,500 square feet area as defined in NFPA 13.
- E. Outside Hose Allowances: Hydraulic calculations shall include an allowance of 250 gpm for outside hose streams.
- F. Friction Losses: Calculate losses in piping in accordance with the Hazen Williams formula with "C" value of 120 for steel piping, 150 for copper tubing, and 140 for cement lined ductile iron piping and asbestos cement piping.
- G. Sprinkler Heads: Heads shall have nominal 0.50 inch orifice. Release element of each head shall be of the ordinary temperature rating or higher as suitable for the specific application. Provide polished stainless steel ceiling plates or chromium plated finish on copper alloy ceiling plates, and chromium plated pendent sprinklers below suspended ceilings. Provide corrosion resistant sprinkler heads and sprinkler head guards as required by NFPA 13.
- H. Aboveground Piping Systems: Inspect, test, and approve piping before covering or concealing. Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through tapered reducing pipe fittings; bushings will not be permitted. Perform welding in the shop; field welding will not be permitted. Conceal piping in areas with suspended ceiling.
  - 1. Sprinkler Pipe and Fittings: Provide in accordance with NFPA 13. Steel piping shall be Schedule 40 for sizes 2 inches and smaller, with ASME B.1.20.1 threaded ends. Steel pipe diameters 2-1/2" and larger shall be Schedule 10, roll grooves. Fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded shall be welded, threaded, or grooved end type. Plain end fittings with mechanical couplings and fittings which use steel gripping devices to bite into the pipe when pressure is applied will not be permitted. Rubber gasketed grooved end pipe and fittings with mechanical couplings shall be permitted in pipe sizes 2-1/2 inches and larger. Fittings shall be UL FPED listed or FM P7825 approved for use in wet pipe sprinkler systems. Fittings,

mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer.

2. Pipe Hangers and Supports: Provide in accordance with NFPA 13.
- I. Pipe Sleeves: Provide where piping passes through walls, floors, roofs, and partitions. Grout sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide clearance between exterior of piping and interior of sleeve in accordance with NFPA 13. Firmly pack space with noncombustible insulation. Caulk both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal.
  1. Sleeves in Masonry and Concrete Walls, Floors, and Roofs: Provide ASTM A53 or ASTM A120, hot dip galvanized steel pipe sleeves. Extend sleeves 3 inches above the finished floor.
  2. Sleeves in Partitions, Non Masonry Walls, Floors, and Roofs: Provide hot dip galvanized steel sheet having a nominal weight of not less than 0.90 psf.
- J. Escutcheon Plates: Provide one piece or split hinge type metal plates for piping passing through floors, walls, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium plated finish on copper alloy plates in finished spaces. Provide paint finish on plates in unfinished spaces. Secure plates in proper position.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Equipment, materials, installation, workmanship, examination, inspection, and testing shall be in accordance with NFPA 13, except as modified herein. Install piping straight and true to bear evenly on hangers and supports. Keep the interior and ends of new piping and existing piping affected by Contractor's operations thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position. Center sprinklers in two directions in ceiling tile.

### 3.02 FIELD PAINTING

- A. Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat of DOD P 15328 pretreatment primer applied to a minimum dry film thickness of 0.3 mil, and one coat of FS TT P 645 primer applied to a minimum dry film thickness of 1.0 mil. Shield

sprinkler heads with protective covering while painting is in process. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

1. Systems in Unfinished Areas: Unfinished areas are defined as attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, and spaces where walls or ceiling are not painted or not constructed of a pre-finished material. Provide primed surfaces with one coat of FS TT E 489 red enamel applied to a minimum dry film thickness of 1.0 mil. In lieu of field painting, Contractor may provide piping with 2 inch wide red enamel bands or self adhering red plastic bands spaced at maximum of 20 foot intervals.
2. Systems in Other Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of FS TT E 489 red enamel applied to a minimum dry film thickness of 1.0 mil. Provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals. In finished areas such as offices, the red bands may be omitted.

### 3.03 TESTING AND FLUSHING

- A. Preliminary Tests: Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in gauge pressure. Flush piping with potable water in accordance with NFPA 13. Piping above suspended ceilings shall be inspected, tested, and approved before installation of ceilings. Test the alarms and other devices. Test the water flow alarms by flowing water through the inspector's test connection. When tests are completed and corrections made, submit a signed and dated certificate, similar to that specified in NFPA 13, with a request for formal inspection and tests.
- B. Formal Inspection and Tests: The Contractor shall notify Engineer and Owner at least 15 days prior to commencement of testing. An experienced technician regularly employed by the system installer shall be present during the testing and inspection. Correct defects in work provided by the Contractor, and make additional tests until the systems comply with all contract requirements. Furnish appliances, equipment, water, electricity, instruments, connecting devices, and personnel for the tests.

END OF SECTION



## SECTION 22 00 00

### PLUMBING GENERAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Plumbing General Requirements, as shown on the Plans, as specified and/or directed.
- B. Related work specified elsewhere:
  - 1. Division 1, "General Requirements"
  - 2. Division 22, "Plumbing"
  - 3. Division 23, "Mechanical"
  - 4. Division 26, "Electrical"

##### 1.02 REFERENCE STANDARDS

- A. The following is a list of standards that may be referenced in this Section:
  - 1. Code of Federal Regulations (CFR) Publications:
    - a. 29-1910 SUBPART O – Machinery and Machine Guarding
    - b. 29-1910.219 – Mechanical Power Transmission Apparatus

##### 1.03 SUBMITTALS

- A. Submit shop drawings, manufacturer's data, publication compliance, certified test reports, and manufacturer's certificates of compliance for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and have them approved before procurement, fabrication or delivery of the items to the job site. Shop drawings shall be accompanied by a letter of transmittal in duplicate, and all shop drawings shall be suitably identified with the name of the project, contract number, Contractor's name, date and initials indicating approval of such submittal by the Contractor under the applicable specification. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and the specific technical paragraph reference which specifies each item, applicable industry and technical society publication references, and other information necessary to establish contract compliance of each item to be furnished.
  - 1. Manufacturer's Data: Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.

2. Shop Drawings: Drawings shall be a minimum of 8.5 inches by 11 inches in size, except as specified otherwise. Drawings shall include floor plans, sectional views, wiring diagrams, and installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
3. Manufacturer's Certificates of Compliance: Submit certification from manufacturer attesting that materials and equipment to be furnished for this project comply with the requirements of this specification and of the reference publications. Pre-printed certifications will not be acceptable; certifications shall be the manufacturer's original; certifications shall be not more than one year old. The certification shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; "equal or exceed the service and performance of the specified material". The certification shall simply state that the product conforms to the requirements specified. Certificates shall be signed by the manufacturer's official authorized to sign certificates of compliance.
4. Reference Standards Compliance: Where equipment or materials are specified to conform to industry and technical society reference standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), American Society of Mechanical Engineers (ASME), American Gas Association (AGA), American Refrigeration Institute (ARI), and Underwriters' Laboratories (UL), proof of such conformance shall be submitted. If an organization uses a label or listing to indicate compliance with a particular reference standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections.
  - a. Independent Testing Organization Certificate: In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing and approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

#### 1.04 OPERATION AND MAINTENANCE MANUAL

- A. Furnish an operation and maintenance manual for each item of equipment.  
Furnish three copies of the manual bound in hardback binders or an approved

equivalent. Furnish one complete manual to the Owner's Representative for review and approval not more than 90 calendar days after an item is approved, but at least 60 calendar days prior to field acceptance testing of the item. Furnish the remaining manuals at least 60 days prior to contract completion. Inscribe the following identification on the cover: the words "OPERATION AND MAINTENANCE MANUAL", the name and location of the equipment or the building, the name of the Contractor, and the contract number. The manual shall include the names, addresses, and telephone numbers of each subcontractor installing equipment, and of the local representatives for each item of equipment. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start up, operation and shut down; description of the function of each principal item of equipment; the procedure for starting; the procedure for operating; shut down instructions; installation instructions; maintenance instructions; lubrication schedule including type, grade, temperature range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts lists for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the project site. The manual shall be complete in all respects for equipment, controls, accessories, and associated appurtenances provided.

#### 1.05 CATALOGED PRODUCTS

- A. Materials and equipment shall be cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturer's latest design that complies with the specification requirements. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the items need not be the products of the same manufacturer. Each item of equipment shall have the manufacturer's name, address, model number and serial number on the nameplate securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

#### 1.06 MANUFACTURER'S RECOMMENDATIONS

- A. Unless otherwise stated in the Contract Specifications, all new equipment items, and specialties shall be installed in strict accordance with the recommendations of the manufacturer of the items being installed. Prior to the installation of new items, the Contractor shall submit to the Owner's representative printed copies of the manufacturer's installation recommendations. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material. Failure to

install items in accordance with manufacturer's recommendations can be cause for rejection of the work items installed.

#### 1.07 LAYOUT OF THE WORK

- A. Coordinate the proper relation of the work to the building structure, existing utilities and to the work of all trades. The Contractor shall advise the Owner's Representative of any discrepancy before performing any work.
  - 1. Contract Drawings: The Contract Drawings represent the general intent as to piping and equipment arrangements. All locations and dimensions shown shall be field verified and minor alterations made if so required. Where dimensions are not given for the location and arrangement of mechanical systems, locations may be assumed to be approximate, and may be altered if required. Major modifications to the indicated arrangements shall be approved by the Owner's Representative prior to the installation of mechanical systems. Schematic diagrams represent the overall system requirements and do not necessarily indicate the physical orientation, location or dimensions of that system.
  - 2. Record Drawings: The Contractor shall maintain a record of the progress of the work and shall submit three (3) sets of As-Built Drawings upon completion of the project.

#### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Properly store, adequately protect, and carefully handle equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Engineer. Replace damaged or defective items.

#### 1.09 SAFETY REQUIREMENTS

- A. Equipment Safety: Fully enclose or properly guard in accordance with 29 CFR 1910.219 belts, pulleys, chains, gears, couplings, projecting setscrews, keys, rotating parts, and other power transmission apparatus, located where persons can come in close proximity thereto. Points of operation, ingoing nip points, and machinery producing flying chips and sparks shall be guarded in accordance with the applicable portions of 29 CFR 1910 SUBPART O. Provide positive means of locking out equipment so that equipment cannot be accidentally started during maintenance procedures. High temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of the type specified. Provide catwalks, maintenance platforms, and guardrails where required for safe operation and maintenance of equipment. Provide ladders or stairways to reach catwalks and maintenance platforms. Ensure that access openings leading to equipment are large enough to carry through routine maintenance items such as filters and tools.

## 1.10 ELECTRICAL REQUIREMENTS

- A. Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Division 26-Electrical. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under this Section. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Division 26 – Electrical. Unless specifically noted otherwise, all control wiring (120 volt or less) shall be provided by Mechanical Contractor and conform to the requirements of Division 26 – Electrical.

## 1.11 INSTRUCTION TO OWNER'S PERSONNEL

- A. When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Owner's personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The number of days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the Contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

## 1.12 INSPECTIONS AND CERTIFICATIONS

- A. The Contractor shall provide and pay for any third party inspections or certifications required by applicable regulatory agencies for boilers and other mechanical equipment components modified, or furnished and installed as a part of the Contract work.

## PART 2 - PRODUCTS

NOT USED

## PART 3 - EXECUTION

### 3.01 FIELD PAINTING

#### A. Painting of New Equipment:

1. Equipment painting, factory applied or shop applied, shall be as specified herein, and provided under each individual section of this Specification.
  - a. Factory Painting Systems: Manufacturer's standard factory painting systems may be provided.
  - b. Shop Painting Systems: Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces shall not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees Fahrenheit (F) shall be cleaned to bare metal. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.
  - c. Metal Surfaces Subject to Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.
  - d. Metal Surfaces Subject to Temperatures Between 120 and 400 Degrees F: Surfaces shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.
  - e. Metal Surfaces Subject to Temperatures Greater Than 400 Degrees F: Surfaces shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

END OF SECTION

## SECTION 22 05 53

### IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for identification of plumbing piping and equipment including all pumps, hot water heaters, storage tanks, piping and valves using color bands, lettering, flow direction arrows, and related permanent identification devices for Identification for Plumbing Piping and Equipment, as shown on the Plans, as specified and/or directed.
- B. Related work specified elsewhere:
  - 1. Section 22 00 00 – Plumbing General Requirements
  - 2. Section 22 07 00 – Plumbing Insulation

##### 1.02 REFERENCE STANDARDS

- A. The following is a list of standards that may be referenced in this Section:
  - 1. American National Standards Institute, Inc. (ANSI) Publication:
    - a. A13.1 – Scheme for the Identification of Piping Systems
    - b. Z535.1 – Safety Color Code

##### 1.03 SUBMITTALS

- A. Manufacturer's Data:
  - 1. Label, Tag and Nameplate materials
  - 2. List of wording, symbols, letter size, and color coding to be used
  - 3. Valve chart
  - 4. Accessory materials

#### PART 2 - PRODUCTS

##### 2.01 MATERIALS

- A. Pipe labels, valve tags and equipment nameplates shall be as manufactured by Marking Services Incorporated, or approved equal.
  - 1. Nameplates: Three-ply laminated phenolic plastic at least 1/16" thick with black surfaces and white core. Engraving shall be minimum 1/2" high with appropriate spacing. Text shall be white on black background. Nomenclature shall match the equipment designation as indicated on the Plans and Schedules.

2. Valve Tags: Three-ply laminated phenolic plastic at least 1/16" thick with black surfaces and white core. Engraving shall be minimum 1/2" high with appropriate spacing. Text shall be white on black background. Valve tag shall be minimum 1-1/2" diameter with smooth edges.
3. Pipe Markers: Color, text and size shall conform to ASME/ANSI Standard A13.1.
  - a. Plastic Pipe Markers: Strap-type labels shall be factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering with flow direction arrows and identification of fluid being conveyed. Straps shall be self-locking nylon ties.
  - b. Plastic Tape Pipe Markers: Self-adhesive flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings with flow direction arrows and identification of fluid being conveyed.
4. Valve Chart: Valve chart(s) shall be printed on 8-1/2"x11" white paper with typewritten black text, minimum 12 point character size. Information to be provided shall be, at a minimum, the number, location, size and function of each line valve installed under this Contract. Chart shall be installed in a glazed frame and permanently mounted to wall in mechanical room or other suitable location coordinated with the Owner.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.02 GENERAL

- A. All markers shall be installed in accordance with manufacturer's printed instructions, and shall be neat and uniform in appearance. All tags or markers shall be oriented such that they are readily visible from all normal working locations. All equipment above lift-out ceilings or made accessible by access doors shall be labeled in the same manner as that of exposed equipment.

### 3.03 NAMEPLATES

- A. Install plastic nameplates with corrosive resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer. Equipment to be labeled shall include but not be limited to the following items: pumps, hot water heaters, storage tanks, water treatment equipment, air compressors, plumbing control devices, switches, control panels and other related devices.



### 3.04 VALVE TAGS

- A. Install valve tags on all valves except simple service and drain valves located within 10 feet and sight distance of the device or equipment served. For example, it would not be expected that strainer blow-down valves in a machine room would be tagged. Each tag shall be attached to its valve with copper clad annealed iron wire, corrosion resistant chain, or other approved material.

### 3.05 PIPE MARKERS

- A. Exposed piping shall be identified at intervals of 20 feet and at least one time in each room. Provide a pipe marker at each valve. Provide arrow markers at each pipe marker with arrows pointing away from the pipe marker to indicate direction of flow. When flow can be in either or both directions, provide a double ended arrow marker. Provide pipe and arrow marker at every point of pipe entry or exit where line penetrates a wall or service chase. Self-adhesive labels shall be used to identify piping under 6 inches in diameter when insulated and covered. For finished pipe sizes 6 inches and larger, strap type markers with self-locking nylon ties shall be utilized.

### 3.06 MISCELLANEOUS EQUIPMENT

- A. Small items such as inline pumps shall be identified with tags in lieu of nameplates. Submit labeling plan to Engineer for devices and equipment not otherwise specified herein.

END OF SECTION

## SECTION 22 07 00

### PLUMBING INSULATION

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Plumbing Insulation as shown on the Plans, as specified and/or directed.
- B. Related work specified elsewhere:
  - 1. Section 22 00 00 – Plumbing General Requirements
  - 2. Section 22 11 16 – Domestic Water Piping
  - 3. Section 22 42 00 – Commercial Plumbing Fixtures

##### 1.02 REFERENCE STANDARDS

- A. The following is a list of standards that may be referenced in this Section:
  - 1. American Society for Testing and Materials (ASTM) Publication:
    - a. A167 – Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and Strip
    - b. C177 – Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus, Test Method
    - c. C195 – Mineral Fiber Thermal Insulating Cement
    - d. C534 – Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
    - e. C547 – Mineral Fiber Preformed Pipe Insulation
    - f. C552 – Cellular Glass Block and Pipe Thermal Insulation
    - g. C553 – Mineral Fiber Blanket and Felt Insulation (Industrial Type)
    - h. C612 – Mineral Fiber Block and Board Thermal Insulation
    - i. C795 – Wicking Type Thermal Insulation for Use Over Austenitic Stainless Steel
    - j. C921 – Properties of Jacketing Materials for Thermal Insulation
    - k. D227 – Coal Tar Saturated Organic Felt Used in Roofing and Waterproofing
    - l. E84 – Surface Burning Characteristics of Building Materials
    - m. E96 – Water Vapor Transmission of Materials
  - 2. Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS) Publication:
    - a. SP 58 – Pipe Hangers and Supports Materials, Design, and Manufacture
    - b. SP 69 – Pipe Hangers and Supports Selection and Application
  - 3. National Fire Protection Association (NFPA) Publication:
    - a. 255 – Surface Burning Characteristics of Building Materials

4. Underwriters Laboratories, Inc. (UL) Publication:
  - a. 723 – Tests for Surface Burning Characteristics of Building Materials
5. Uniform Fire Prevention and Building Code of New York State Publication:
  - a. 2020 – Plumbing Code of New York State
  - b. 2020 – Energy Conservation Construction Code of New York State

### 1.03 SUBMITTALS

- A. Manufacturer's Data:
  1. Insulation
  2. Jackets
  3. Vapor-barrier materials
  4. Accessory materials
- B. Standards Compliance: Standards compliance labels are requirements on each container or package
  1. Insulation
  2. Jackets
  3. Vapor-barrier materials
  4. Accessory materials

### 1.04 DEFINITIONS

- A. Finished Spaces: Spaces used for habitation or occupancy where rough surfaces are plastered, paneled, or otherwise treated to provide a pleasing appearance.
- B. Unfinished Spaces: Spaces used for storage or work areas where appearance is not a factor, such as unexcavated spaces and crawl space.
- C. Concealed Spaces: Spaces out of sight. For example, above ceilings; below floors; between double walls; furred in areas; pipe and duct shafts; and similar spaces.
- D. Exposed: Open to view. For example, pipe running through a room and not covered by other construction.
- E. Fugitive Treatments: Treatments subject to deterioration due to aging, moisture, high humidity, oxygen, ozone, and heat. Fugitive materials are entrapped materials that can cause deterioration, such as solvents and water vapor.
- F. Outside: Open to view up to 5 feet beyond the exterior side of walls, above the roof, and unexcavated or crawl spaces.

## 1.05 MANUFACTURER'S STAMP OR LABEL

- A. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to the project site for use must have the manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material. Insulation packages and containers shall be asbestos free.

## 1.06 FLAME SPREAD AND SMOKE DEVELOPED RATINGS

- A. In accordance with NFPA 255, ASTM E84 or UL 723, the materials shall have a flame spread rating of not more than 25 and a smoke developed rating of not more than 50.
  - 1. Materials Tests: Test factory applied materials as assembled. Field applied materials may be tested individually. Use no fugitive or corrosive treatments to impart flame resistance. UL label or satisfactory certified test report from a testing laboratory will be required to indicate that fire hazard ratings for materials proposed for use do not exceed those specified. Flame proofing treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.
  - 2. Materials Exempt From Fire Resistant Rating: Nylon anchors.
- B. Materials Exempt from Fire Resistant Rating When Installed In Outside Locations, Buried, or Encased In Concrete: PVC casing and glass fiber reinforced plastic casing.

## PART 2 - PRODUCTS

### 2.01 PIPING SYSTEMS INSULATION

- A. Piping systems (except buried pipe) requiring insulation, types of insulation required, and insulation thickness shall be as listed in Tables I and II herein. Except for flexible unicellular insulation, insulation thicknesses as specified in Table II shall be one inch greater for insulated piping systems located outside. Unless otherwise specified, insulate all fittings, flanges, and valves, except valve stems, hand wheels, and operators. Use factory premolded, precut, or field fabricated insulation of the same thickness and conductivity as used on adjacent piping. Insulation exterior shall be factory cleanable, grease resistant, non-flaking and non-peeling. Pipe insulation shall conform to the referenced publications in Table I.
  - 1. Flexible Unicellular Insulation: ASTM C534. The minimum density limit of 4.5 pounds per cubic foot may be waived if all other characteristics of the standard are met.
  - 2. Wicking Type Insulation: ASTM C795. Use over austenitic stainless steel.
  - 3. Piping Insulation Finishes:
    - a. All Purpose Jacket: Except calcium silicate and unicellular insulation, provide a factory applied all-purpose jacket with or

without integral vapor barrier as required by the service. Provide jackets in exposed locations with a white surface suitable for field painting. Allow a maximum water vapor permeance of 0.05 perm per ASTM E96, a puncture resistance of not less than 50 Beach units, and a minimum tensile strength of 35 pounds force per inch of width.

- b. Vapor Barrier Material: Resistant to flame, moisture penetration, and mold growth. Provide vapor barrier material on pipe insulation as required in Table I.

- B. Vinyl Lacquer: Two coats of vinyl lacquer finish or equivalent according to the manufacturer's recommendations for unicellular insulation located outside.

## 2.02 EQUIPMENT

- A. Insulate all equipment and accessories as specified in Table III and IV. In outside locations, provide insulation one inch thicker than specified. Increase the specified insulation thickness for equipment only where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface. Additional insulation is not required for factory insulated equipment.

## 2.03 ADHESIVES, SEALANTS, AND COATING COMPOUNDS

- A. Adhesive for Securing Insulation to Metal Surfaces and Vapor Barrier Lap Adhesive (For Use in Building Interior Only): ASTM C916, Type I (an adhesive in which the vehicle is nonflammable in liquid (wet) state and which will pass the edge burning test), or Type II (An adhesive in which the vehicle is nonflammable in the liquid (wet) state and which will not pass the edge burning test).
- B. Mineral Fiber Insulation Cement: ASTM C195, thermal conductivity 0.85 maximum at 200 degrees F mean when tested per ASTM C177.
- C. Weatherproof Coating: For outside applications use a weatherproof coating recommended by the manufacturer of the insulation and jackets.

## 2.04 ACCESSORIES

- A. Staples: ASTM A167, Type 304 stainless steel outside clinch type.
- B. Insulation Bands: 3/4 inch wide; 0.20 inch aluminum.
- C. Anchor Pins: Provide anchor pins and speed washers recommended by the insulation manufacturer.
- D. Glass Cloth and Tape: Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces per square yard. In lieu of glass cloth and tape, open weave glass membrane may be used.

- E. Coal Tar Saturated Organic Felt: ASTM D227, minimum weight of 13 pounds per 100 square feet.
- F. Wire: Soft annealed stainless steel, 0.047 inch nominal diameter.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Do not insulate materials until all system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust, and scale and dried. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction with valve handle, safety relief, etc. Allow adequate space for pipe expansion. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Insulation shall be continuous through sleeves, wall and ceiling openings. Extend all surface finishes to protect all surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer's recommended coverage per gallon. Individually insulate piping. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during the application of any finish. Bevel and seal the edges of exposed insulation. Unless otherwise indicated, do not insulate the following:
  - 1. Vertical portion of interior roof drain pipelines, chrome plated pipes, and fire protection pipes.
  - 2. Vibration isolating connections.
  - 3. Adjacent insulation.
  - 4. ASME stamps.

### 3.02 PIPING INSULATION

- A. Pipe Insulation (Except Unicellular Insulation): Installation of plumbing insulation including materials and workmanship shall be in accordance with the Energy Conservation Construction Code of New York State, except as modified herein. Place sections of insulation around the pipe and joints tightly butted into place. The jacket laps shall be drawn tight and smooth. Secure jacket with fire resistant adhesive, factory applied self-sealing lap, or stainless steel outward clinching staples spaced not over 4 inches on centers and 1/2 inch minimum from edge of lap. Cover circumferential joints with butt strips, not less than 3 inches wide, of material identical to the jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inches. Adhesive used to secure the butt strip shall be the same as used to secure the jacket laps. Apply staples to both edges of the butt strips. When a vapor barrier jacket is required, as indicated in TABLE I, or on the ends of sections of insulation that butt against flanges, unions, valves, and fittings, and joints, use a vapor barrier coating or manufacturer's weatherproof

coating for outside service. Apply this vapor barrier coating at all longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend the patch not less than 1-1/2 inches past the break in both directions. At penetrations by pressure gauges and thermometers, fill the voids with the vapor barrier coating for outside service. Seal with a brush coat of the same coating. Do not use staples to secure jacket laps on pipes carrying fluid medium at temperatures below 35 degrees F. Where penetrating roofs, insulate piping to a point flush with the top of the flashing and seal with the vapor barrier coating. Butt tightly the exterior insulation to the top of the flashing and interior insulation. Extend the exterior metal jacket 2 inches down beyond the end of the insulation. Seal the flashing and counterflashing underneath with the vapor barrier coating. In cold water piping in high humidity areas, use cellular glass, or flexible unicellular insulation.

- B. Flexible Unicellular Insulation: Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90 degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral fiber insulation inserts and sheet metal sleeves. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Apply two coats of vinyl lacquer finish to flexible unicellular insulation in outside locations.
- C. Hangers and Anchors: Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by the insulation, provide MSS SP 58, Type 40 galvanized steel shields or MSS SP 58, Type 39 protection saddles conforming to MSS SP 69. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports. Insulation inserts shall be of cellular glass (minimum 8 pcf), molded glass fiber (minimum 8 pcf), or other approved material of the same thickness as adjacent insulation. Inserts shall have sufficient compressive strength to adequately support the pipe without compressing the inserts to a thickness less than the adjacent insulation. Insulation inserts shall cover the bottom half of the pipe circumference 180 degrees and be not less in length than the protection shield. Vapor barrier facing of the insert shall be of the same material as the facing on the adjacent insulation. Seal inserts into the insulation with vapor barrier coating, or for exterior work, manufacturers recommended weatherproof coating, as applicable. Where protection saddles are used, fill all voids with the same insulation material as used on the adjacent pipe.
- D. Sleeves and Wall Chases: Where penetrating interior walls, extend a metal jacket 2 inches out on either side of the wall and secure on each end with a band. Where penetrating floors, extend a metal jacket from a point below the back-up material to a point 10 inches above the floor with one band at the floor and one not more than one inch from end of metal jacket. Where penetrating exterior walls, extend the metal jackets through the sleeve to a point 2 inches beyond the interior surface of the wall.

- E. Flanges, Unions, Valves and Fittings Insulation (Except Flexible Unicellular) for Hot Piping: Factory fabricated removable and reusable insulation covers may be used. For inside domestic hot water, high temperature hot water systems, and exposed hot water piping and drains in handicap areas, place factory premolded, precut or field fabricated segmented insulation of the same thickness and conductivity as the adjoining pipe insulation around the flange, union, valve, and fitting abutting the adjoining pipe insulation. If nesting size insulation is used, overlap 2 inches or one pipe diameter whichever is larger. Use insulating cement to fill voids. Elbows insulated using segments shall have not less than three segments per elbow. Place and joint the segments with manufacturer's recommended water vapor resistant, fire retardant, and adhesive appropriate for the temperature limit of the service. Upon completion of installation of insulation, apply two coats of lagging adhesive with glass tape embedded between coats. Overlap tape seams one inch. Extend adhesive onto adjoining insulation not less than two inches. The total dry film thickness shall be not less than 1/16 inch. Where unions are indicated not to be insulated, taper the insulation to the union at a 45 degree angle. Coat the insulation and all-purpose jacket with two coats of lagging adhesive and with glass tape embedded between coats. The total dry film thickness shall be not less than 1/16 inch. At the option of the Contractor, factory premolded one piece PVC fitting covers may be used in lieu of two coats of adhesive with tape embedded between coats. Factory premolded field fabricated segment or blanket insert insulation shall be used under the fitting covers. Install factory premolded one piece PVC fitting covers over the insulation and secure by stapling, taping with PVC vapor barrier tape, or with metal or plastic tacks made for securing PVC fitting covers. Do not use PVC fitting covers where exposed to the weather. Limit the use of PVC fitting covers to ambient temperatures below 150 degrees F.
- F. Flanges, Unions, Valves, Anchors, Fittings for Cold Piping: Factory fabricated removable and reusable insulation covers may be used. For piping insulation inside the building that service domestic cold water above ceilings, drinking fountain drain piping to sewer tie in, horizontal roof drain leaders, and exposed laboratory drains, coat pipe insulation ends with vapor barrier coating not more than six inches from each flange, union, valve, anchor or fitting. Place insulation of the same thickness and conductivity as the adjoining pipe insulation (either premolded or segmented) around the item, butting the adjoining pipe insulation. If nesting size insulation is used, overlap the insulation 2 inches or one pipe diameter. Use loose fill mineral wool or insulating cement to fill the voids. Elbows insulated using segments shall not have less than 3 segments per elbow. Insulation may be secured by wire or tape until finish coating is applied. Apply two coats of vapor barrier coating with glass tape embedded between coats. Overlap tape seams one inch. Extend the coating out onto the adjoining pipe insulation 2 inches. Where unions are shown not to be insulated, the insulation shall be tapered to the union at a 45 degree angle. Seal the insulation and jacket with two coats of vapor barrier coating with glass tape embedded between coats. Insulate anchors attached directly to the pipe for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface. Insulate



flexible connections at pumps and other equipment with unicellular plastic insulation, unless otherwise indicated. At the option of the Contractor, premolded, one piece polyvinyl chloride (PVC) fitting covers may be used in lieu of the embedded glass tape. Factory premolded insulation or field fabricated insulation segments shall be used under the fitting covers. Blanket inserts may be used. Secure the covers with adhesive and vapor barrier tape with a vapor resistance of maximum 0.05 perm per ASTM E96, or with tacks made for securing PVC covers. Then coat all tape seams and tacks with Type II vapor barrier coating. Do not use premolded PVC fitting covers where exposed to weather. Limit the use of PVC covers to not less than 35 degrees F medium temperatures and below 150 degrees F ambient temperatures.

### 3.03 EQUIPMENT INSULATION

- A. General Procedures: Installation of plumbing equipment insulation including materials and workmanship shall be in accordance with the New York State Energy Conservation Code, except as modified herein. Apply equipment insulation suitable for temperature and service in rigid block or semirigid board or flexible form to fit as closely as possible to equipment. Groove or score insulation where necessary to fit the contours of equipment. Stagger end joints where possible. Bevel the edges of the insulation for cylindrical surfaces to provide tight joints. Join sections of cellular glass insulation with bedding compound. After the cellular glass insulation is in place on areas to be insulated, except where metal encased, fill joints, seams, chipped edges, or depressions with bedding compound to form a smooth surface. Fill mineral fiber joints with insulating cement conforming to ASTM C195. Bevel insulation around name plates, ASME Stamp, and access plates. For insulation on equipment that must be opened periodically for inspection, cleaning, or repair, construct insulation to be removable and replaceable without damage. Protect exposed insulation corners with corner angles under wires and bands.

### 3.04 REPLACEMENT OF EXISTING ASBESTOS INSULATION

- A. When existing asbestos insulation is to be replaced, provide new asbestos free insulation. Label or stencil new insulation "Asbestos Free" after final finishing and painting.

### 3.05 FIELD INSPECTION

- A. Visually inspect to ensure that materials used conform to specifications. Inspect installations progressively for compliance with requirements.

TABLE I INSULATION MATERIAL FOR PIPING					
SERVICE	MATERIAL	SPEC.	TYPE	CLASS	VAPOR BARRIER REQUIRED
*Domestic Hot Water and Hot Water Recirculating Piping	Mineral Fiber	ASTM C547		1	No
	Cellular Glass	ASTM C552	II	2	No
	Flexible Unicellular	ASTM C534	I or II		No
Domestic Cold Water Piping Above Ceilings	Mineral Fiber	ASTM C547		1	Yes
	Cellular Glass	ASTM C552	II	2	No
	Flexible Unicellular	ASTM C534	I or II		No
Drinking Fountain, Drain Piping (to sewer tie in)	Mineral Fiber	ASTM C547		1	Yes
	Cellular Glass	ASTM C552	II	2	No
	Flexible Unicellular	ASTM C534	I or II		No
*NOTE: If there is no condensation condition existing, insulation is not required for CPVC or PVC piping.					

TABLE II PIPING INSULATION WALL THICKNESS						
SERVICE	MATERIAL	TUBE AND PIPE SIZE (INCHES)				
		1/4 - 3/4	1 - 1-1/4	1-1/2 - 3	4 - 6	8+
Domestic Water (Hot and Recirculating), and Insulated Drains	Mineral Fiber	1	1	1-1/2	1-1/2	1-1/2
	Cellular Glass	1	1	1-1/2	1-1/2	1-1/2
	Flexible Unicellular	1	1	1-1/2	1-1/2	1-1/2
Domestic Cold Water	Mineral Fiber	1/2	1/2	1	1	1
	Cellular Glass	1/2	1/2	1	1	1
	Flexible Unicellular	1/2	1/2	1	1	1

TABLE III INSULATION FOR EQUIPMENT				
MATERIAL	SPEC	TYPE	CLASS	VAPOR BARRIER REQUIRED
Flexible Mineral Fiber	ASTM C553	I	B-3	No
Rigid Mineral Fiber or Cellular Glass	ASTM C612		2	No
	ASTM C552	I		No
Flexible Unicellular	ASTM C534	II		No

END OF SECTION

## SECTION 22 11 16

### DOMESTIC WATER PIPING

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Domestic Water Piping, as shown on the Plans, as specified and/or directed.
- B. Related work specified elsewhere:
  - 1. Section 22 00 00 – Plumbing General Requirements
  - 2. Section 22 42 00 – Commercial Plumbing Fixtures

##### 1.02 REFERENCE STANDARDS

- A. The following is a list of standards that may be referenced in this Section:
  - 1. American National Standards Institute (ANSI) Publication:
    - a. A112.26.1M - Water Hammer Arrestor
    - b. B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings
    - c. B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
    - d. B16.23 – Cast Copper Alloy Solder Joint Drainage Fittings –DWV
    - e. B16.24 – Bronze Pipe Flanges and Flanged Fittings, Class 150 and 300
    - f. B16.26 – Cast Copper Alloy Fittings for Flared Copper Tubes
    - g. B16.39 – Malleable Iron Threaded Pipe Unions, Class 150, 250 and 300
  - 2. American Society of Mechanical Engineers (ASME) Publication:
    - a. B40.100 – Pressure Gauges and Attachments
    - b. B40.200 – Thermometers, Dial Reading and Remote Reading
  - 3. American Society for Testing and Materials (ASTM) Publication:
    - a. A48 – Gray Iron Castings
    - b. A126 – Gray Iron Castings for Valves, Flanges, and Pipe Fittings
    - c. B32 – Solder Metal
    - d. B61 – Steam or Valve Bronze Castings
    - e. B62 – Composition Bronze or Ounce Metal Castings
    - f. B88 – Seamless Copper Water Tube
    - g. D2846 – Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot and Cold Water Distribution Systems
    - h. F439 – Socket Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
    - i. F441 – Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
    - j. F493 – Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

4. American Society of sanitary Engineering (ASSE) Publication:
  - a. 1003 – Water Pressure Reducing Valves for Domestic Water Supply Systems
  - b. 1010 – Water Hammer Arresters
  - c. 1019 – Wall Hydrants, Frost Proof Automatic Draining, Anti backflow Types
5. American Water Works Association (AWWA) Publication:
  - a. C104 – Cement Mortar Lining for Ductile Iron and Gray Iron Pipe and Fitting for Water
  - b. C105 – Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids
  - c. C110 – Gray Iron and Ductile Iron Fittings, 3 in. Through 48 in. for Water and Other Liquids
  - d. C111 – Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
  - e. C115 – Flanged Ductile Iron and Gray Iron Pipe with Threaded Flanges
  - f. C500 – Gate Valves, 3 Through 48 inch NPS, for Water and Sewage Systems
  - g. C504 – Rubber Seated Butterfly Valves
  - h. C651 – Disinfecting Water Mains
  - i. C700 – Cold Water Meters, Displacement Type
  - j. C701 – Cold Water Meters, Turbine Type for Customer Service
  - k. C702 – Cold Water Meters, Compound Type
6. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publication:
  - a. SP 58 – Pipe Hangers and Supports Materials, Design and Manufacture
  - b. SP 67 – Butterfly Valves
  - c. SP 69 – Pipe Hangers and Supports Selection and Application
  - d. SP 70 – Cast Iron Gate Valves, Flanged and Threaded Ends
  - e. SP 80 – Bronze Gate, Globe, Angle and Check Valves
  - f. SP 85 – Cast Iron Globe and Angle Valves, Flanged and Threaded Ends
7. Plumbing and Drainage Institute (PDI) Publication:
  - a. WH201 – Water Hammer Arresters
8. Uniform Fire Prevention and Building Code of New York State Publication:
  - a. 2020 – Plumbing Code of New York State
9. Foundation for Cross Connection Control and Hydraulic Research, University of Southern California (FCCCHR) Publication:
  - a. List of Approved Backflow Prevention Assemblies (Obtain current date from NAVFAC HQ, Code 04)

### 1.03 GENERAL REQUIREMENTS

- A. Section 22 00 00, "Plumbing General Requirements", applies to this Section, with the additions and modifications specified herein. Plumbing systems including equipment, materials, installation, and workmanship shall be in accordance with the Plumbing Code of New York State, except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears. Capacity of equipment shall be not less than that indicated. Plumbing systems shall include all water piping buried and aboveground to a limit of 5 feet outside of the building walls unless otherwise specified, or indicated by the Contract Drawings.

### 1.04 SUBMITTALS

- A. Manufacturer's Data:
  - 1. Pipe and fittings
  - 2. Valves and Valve Boxes
  - 3. Pipe supports (hangers)
  - 4. Gauges and thermometers
  - 5. Water meters
  - 6. Strainers
  - 7. Water hammer arresters
  - 8. Backflow preventers
- B. Shop Drawings:
- C. Certificates of Conformance
  - 1. Pipe and fittings
  - 2. Valves
  - 3. Backflow preventers

## PART 2 - PRODUCTS

### 2.01 DOMESTIC WATER PIPING

- A. Buried Piping and Aboveground Piping:
  - 1. Copper Tubing: ASTM B88, Type K, with ANSI B16.26 flared joint fittings for all below ground piping. ASTM B88, Type L, with ANSI B16.18 or ANSI B16.22 solder joint fittings using ASTM B32, 95-5 tin-antimony or grade Sn96 tin-silver solder, and flux containing not more than 0.2% lead, shall be provided for aboveground piping.
  - 2. Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe, Fittings, and Solvent Cement:
    - a. Piping Sizes 0.75 Inch and 0.50 Inch: ASTM D2846.

- b. Piping Sizes One Inch through 2 Inches: ASTM F441, Schedule 80 pipe; ASTM F439, Schedule 80 fittings; and ASTM F493 solvent cement.
  3. Cast Ductile Iron Piping: Sizes 4 inches and larger, outside coated, AWWA C104 cement mortar lined, AWWA C151 ductile iron pipe, AWWA C111 rubber gasket joints, and AWWA C110 fittings. Provide concrete thrust blocks at the elbow where the buried piping turns up toward the floor, and restrain the pipe riser with steel rods from the elbow to the flange above the floor. Aboveground piping shall have flanged end connections conforming to AWWA C115 for flanged pipe and AWWA C110 for flanged fittings.
- B. Water Valves: Provide valves suitable for minimum of 125 psig and minimum of 180 degrees F hot water. Valves shall have threaded end connections with a union on all but one side of the valve, or solder end connections between bronze valves and copper tubing. Copper alloy and bronze valve body shall be ASTM B61 or ASTM B62 copper alloy. Ball valves may be provided in lieu of gate valves.
  1. Gate Valves 2-1/2" and Larger: Class 125 iron body, bronze mounted, ASTM A126 Class B cast iron body and bonnet, flanged ends, Teflon-impregnated packing and two-piece packing gland. Manufacture shall be as by Stockham, Crane, Powell, or equal.
  2. Gate Valves 2" and Smaller: Class 125, ASTM B62 cast bronze composition body and bonnet, soldered ends, solid disc, copper-silicon alloy stem, brass packing gland, Teflon-impregnated packing and malleable hand wheel. Manufacture shall be as by Stockham, Crane, or equal.
  3. Ball Valves 2" and Smaller: 600 psi cwp, cast brass bodies, two-position hand levers, replaceable reinforced Teflon seats, conventional port, blow-out proof stems, chrome-plated brass ball, soldered ends with extended solder cups. Manufacture shall be as by Stockham, Crane, Apollo, or equal.
  4. Globe Valves 2-1/2" and Larger: Class 125 iron body, bronze mounted with ASTM A-126 Class B cast iron body and bonnet, flanged ends, Teflon-impregnated packing and two-piece packing gland assembly. Manufacture shall be as by Stockham, Crane, Powell, or equal.
  5. Globe Valves 2" and Smaller: Class 125, ASTM B62 cast bronze composition body and bonnet, soldered ends, copper silicon alloy stem, brass packing gland, Teflon-impregnated packing and malleable hand wheel. Manufacture shall be as by Stockham, Crane, Powell, or equal.
  6. Butterfly Valves 2-1/2" and Larger: Wafer type, 200 psi cwp, ASTM A126 Class B cast iron body, replaceable EPDM sleeve, ductile nickel-plated disc, 410 stainless steel stem and EPDM O-ring stem seals. 2-1/2"-6" sizes – lever operated; 8"-24" – gear operated. Manufacture shall be as by Stockham, Crane, or equal.

7. Check Valves 2-1/2" and Larger: Iron body, bronze mounted, ASTM A126 Class B cast iron body and cap, flanged ends and swing disc type. Manufacture shall be as by Stockham, Crane, Powell, or equal.
  8. Check Valves 2" and Smaller: Class 125, soldered ends, ASTM B62 cast bronze composition bodies and caps and swing disc type. Manufacture shall be as by Stockham, Crane, Powell, or equal.
  9. Hose Bibbs: Provide angle type copper alloy hose bibb with lockshield and hand wheel. Inlet shall have internal threads. Outlet shall have vacuum breaker with 0.75 inch external hose threads.
  10. Nonfreeze Wall Hydrant: ASSE 1019, cast bronze, with lockshield and hand wheel, one inch external thread inlet, 0.75 inch external hose thread outlet with automatic draining vacuum breaker. Hydrant shall be of sufficient length to extend through walls and place the valve seat inside the building or in the crawl space. Bonnet and valve stem shall be removable from outside of the building.
  11. Water Pressure Reducing Valves: ASSE 1003.
- C. Strainers: Class 125, Style Y, cast bronze body, 20 mesh stainless steel screen and shall have blow-off outlet with pipe nipple and gate valve. Manufacture shall be as by Watts, Sarco, or equal.
- D. Gauges: ASME B40.100, single style pressure gauge for water with 4 inch dial, brass or aluminum case, bronze tube, gauge cock, pressure snubber, and syphon. Provide scale range suitable for the intended service.
- E. Thermometers: ASME 40.200, bi metal dial type thermometers with stainless steel case, stem, and fixed thread connection; 5 inch diameter dial with glass face gasketed within the case; accuracy within 1.0 percent of scale range. Provide scale range suitable for the intended service.
- F. Dielectric Connections: Provide at connections between copper and ferrous metal piping materials. ASTM F441, Schedule 80, CPVC threaded pipe nipples, 4 inch minimum length, may be provided for dielectric connections in pipe sizes 2 inches and smaller.
- G. Water Hammer Arresters: PDI WH201, ANSI A112.26M.1, or ASSE 1010, elastomer bellows or plunger type with stainless steel or copper shell. Manufacture shall be as by Josam, Zurn, Watts, or equal.
- H. Valve Boxes: For each buried valve provide ASTM A48 cast iron or ductile iron of a suitable size. Provide cast iron or ductile iron cover for the box with the word "WATER" cast on the cover. Coat cast iron and ductile iron boxes with bituminous paint.

## 2.02 MISCELLANEOUS PIPING MATERIALS

- A. Pipe Nipples: ANSI B16, copper alloy for use in copper tubing and hot dip galvanized Schedule 80 steel pipe for use in steel piping.



- B. Unions: ANSI B16 for use in copper tubing; ANSI B16.39 hot dip galvanized steel for use in steel piping.
- C. Flanges: ANSI B16.1, Class 125, for use in ferrous piping; ANSI B16.22 or ANSI B16.24 for use in copper tubing; with full face flat type synthetic rubber gaskets.
- D. Escutcheon Plates: One piece or split hinge type metal plates for piping passing through floors, walls, and ceilings in exposed spaces, chromium plated finish on plates in finished spaces, paint finish on plates in unfinished spaces, and with setscrews or other approved positive means to anchor plates in place securely.
- E. Pipe Sleeves:
  - 1. Sleeves in Masonry and Concrete Walls, Floors, and Roofs: ASTM A53 or ASTM A120, Schedule 40 or Standard Weight, hot dip galvanized steel pipe sleeves.
  - 2. Sleeves in Partitions and Other Than Masonry and Concrete Walls, Floors, and Roofs: Hot dip galvanized steel sheet having a nominal weight of not less than 0.90 pounds per square foot.
- F. Pipe Hangers and Supports: Provide MSS SP 58 and MSS SP 69, Type 1 or 6, of the adjustable type, except as modified herein or indicated otherwise. Attachments to steel W or S beams shall be with Type 21, 28, 29, or 30 clamps. Attachments to steel angles and channels (with web vertical) shall be with Type 20 clamp with a beam clamp channel adaptor. Attachments to steel channel web horizontal) shall be with drilled hole on center line and double nut and washer. Attachments to concrete shall be with Type 18 insert or a drilled hole with expansion anchor. Attachments to wood shall be as indicated. Hanger rods and attachments shall be full size of the hanger threaded diameter. Provide Type 40 insulation protection shields for insulated piping. Provide steel support rods. Provide nonmetallic, hair felt, or plastic piping isolators between copper tubing and the hangers.
- G. Access Doors: Provide 12 by 12 inch factory prefabricated and primed flush face steel access doors including steel door frame with continuous hinges and turn screw operated latch. Door frame shall be for installation in plaster and masonry walls. Furnish doors under this Section to provide proper access to concealed valves; install doors under the appropriate section of this Specification.

## 2.03 PIPE, VALVE AND EQUIPMENT INSULATION

- A. Section 22 07 00, "Plumbing Insulation".

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Installation of plumbing systems including equipment, materials, and workmanship shall be in accordance with the Plumbing Code of New York State, except as modified herein. When fixtures require both hot water and cold water supplies, provide the hot water supply to the left of the cold water supply. Plastic piping shall not penetrate fire walls or fire floors and shall be used on one side of fire walls and fire floors not closer than 6 inches to the penetration.
1. Threaded Connections: Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil; apply only on male threads.
  2. Solder End Valves: Remove stems and washers and other item subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering.
  3. Pipe Supports (Hangers): Provide additional supports at the concentrated loads in piping between supports, such as for in-line water pumps and flanged valves.
    - a. Piping to Receive Insulation: Provide temporary wood spacers between the insulation protection shield and the pipe in order to properly slope the piping and to establish final elevations. Temporary wood spacers shall be of the same thickness as the insulation to be provided under Section 22 07 00, "Plumbing Insulation".
    - b. Maximum Spacing Between Supports:
      - 1) Vertical Piping: Support metal piping at each floor, but at not more than 10 foot intervals.
      - 2) Horizontal Piping: Support cast iron piping at 5 foot intervals, except for pipe exceeding 5 foot length, provide supports at intervals equal to the pipe length but not exceeding 10 feet. Support steel piping and copper tubing as follows:

MAXIMUM SPACING (FEET)						
Nominal Pipe Size (Inches)	One and Under	1.25	1.5	2	2.5	3 and Over
Steel Pipe	7	8	9	10	11	12
Copper Tube	6	6	8	8	9	10

4. Ductile Iron Pipe Aboveground: Provide flanged joints.
5. Installation of Pipe Sleeves: Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient

length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25 inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation, and calk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material. Extend sleeves in floor slabs 3 inches above the finished floor.

### 3.02 NAMEPLATES

- A. Provide laminated plastic nameplates for equipment, gauges, thermometers, and valves; stop valves in supplies to fixtures will not require nameplates. Laminated plastic shall be 0.125 inch thick melamine plastic, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information.
1. Manufacturer, type, and model number
  2. Contract number and accepted date
  3. Capacity or size
  4. System in which installed
  5. System which it controls

### 3.03 FIELD TESTING

- A. Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the following tests in addition to the tests specified in the Plumbing Code of New York State, except as modified herein. Correct all defects in the work provided by the Contractor, and repeat the tests until the work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for the tests.
1. Domestic Water Piping: Before insulation is applied, hydrostatically test each piping system at not less than 100 psig or working pressure plus 50%, whichever is greater with no leakage or reduction in gauge pressure for 2 hours.

### 3.04 DISINFECTION

- A. Thoroughly flush entire system prior to disinfection. Disinfect the new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C601. Fill the piping systems with solution containing minimum of

50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Maintain a minimum of 25 ppm during retention period. Repeat chlorination as required to achieve 25 ppm minimum. Flush the solution from the systems with clean water until maximum residual chlorine content is not greater than 0.2 parts per million.

END OF SECTION

## SECTION 22 13 16

### SANITARY WASTE AND VENT PIPING

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Sanitary Waste and Vent Piping as shown on the Plans, as specified and/or directed.
- B. Related work specified elsewhere:
  - 1. Section 22 00 00 – Plumbing General Requirements
  - 2. Section 22 42 00 – Commercial Plumbing Fixtures

##### 1.02 REFERENCE STANDARDS

- A. The following is a list of standards that may be referenced in this Section:
  - 1. American National Standards Institute (ANSI) Publication:
    - a. B16.1 – Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
    - b. B16.3 – Malleable Iron Threaded Fittings
    - c. B16.12 – Cast Iron Threaded Drainage Fittings
    - d. B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings
    - e. B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
    - f. B16.23 – Cast Copper Alloy Solder Joint Drainage Fittings –DWV
    - g. B16.24 – Bronze Pipe Flanges and Flanged Fittings, Class 150 and 300
    - h. B16.26 – Cast Copper Alloy Fittings for Flared Copper Tubes
    - i. B16.29 – Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings DWV
    - j. B16.32 – Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems
    - k. B16.39 – Malleable Iron Threaded Pipe Unions, Class 150, 250 and 300
  - 2. American Society for Testing and Materials (ASTM) Publication:
    - a. A47 – Ferritic Malleable Iron Castings
    - b. A53 – Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless
    - c. A74 – Cast Iron Soil Pipe and Fittings
    - d. A120 – Pipe, Steel, Black and Hot Dipped, Zinc Coated (Galvanized) Welded and Seamless for Ordinary Uses
    - e. A183 – Carbon Steel Track Bolts and Nuts
    - f. A536 – Ductile Iron Castings
    - g. B32 – Solder Metal

- h. B61 – Steam or Valve Bronze Castings
- i. B62 – Composition Bronze or Ounce Metal Castings
- j. B88 – Seamless Copper Water Tube
- k. B306 – Copper Drainage Tube (DWV)
- l. C564 – Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- m. D2000 – Classification System for Rubber Products in Automotive Applications
- n. D2564 – Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- o. D2661 – Acrylonitrile Butadiene Styrene (ABS) Plastic Drain, Waste, and Vent Pipe and Fittings
- p. D2665 – Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
- 3. American Water Works Association (AWWA) Publication:
  - a. C104 – Cement Mortar Lining for Ductile Iron and Gray Iron Pipe and Fitting for Water
  - b. C105 – Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids
  - c. C110 – Gray Iron and Ductile Iron Fittings, 3 in. Through 48 in. for Water and Other Liquids
  - d. C111 – Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
  - e. C115 – Flanged Ductile Iron and Gray Iron Pipe with Threaded Flanges
  - f. C151 – Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water and Other Liquids
  - g. C500 – Gate Valves, 3 Through 48 inch NPS, for Water and Sewage Systems
- 4. Cast Iron Soil Pipe Institute (CISPI) Publication:
  - a. 301 – Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
  - b. 310 – Patented Joint for Use in Connection with Hubless Cast Iron Sanitary System
  - c. HSN – Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings
- 5. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publication:
  - a. SP 58 – Pipe Hangers and Supports-Materials, Design and Manufacture
  - b. SP 69 – Pipe Hangers and Supports-Selection and Application
  - c. SP 70 – Cast Iron Gate Valves, Flanged and Threaded Ends
  - d. SP 80 – Bronze Gate, Globe, Angle and Check Valves
  - e. SP 85 – Cast Iron Globe and Angle Valves, Flanged and Threaded Ends
- 6. Plumbing and Drainage Institute (PDI) Publication:
  - a. G101 – Testing and Rating Procedure for Grease Interceptors

7. Uniform Fire Prevention and Building Code of New York State  
Publication:
  - a. 2020 – Plumbing Code of New York State

### 1.03 GENERAL REQUIREMENTS

- A. Section 22 00 00, "Plumbing General Requirements", applies to this Section, with the additions and modifications specified herein. Plumbing systems including equipment, materials, installation, and workmanship shall be in accordance with the Plumbing Code of New York State, except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears. Capacity of equipment shall be not less than that indicated. Plumbing systems shall include all water piping buried and aboveground to a limit of 5 feet outside of the building walls unless otherwise specified, or indicated by the Contract Drawings.

### 1.04 SUBMITTALS

- A. Manufacturer's Data:
  1. Pipe and fittings
  2. Valves
  3. Pipe supports (hangers)
  4. Drains
  5. Cleanouts
- B. Certificates of Conformance:
  1. Pipe and fittings

## PART 2 - PRODUCTS

### 2.01 DWV (DRAIN, WASTE, AND VENT) PIPING

- A. Fittings shall be long radius fittings, except fittings in vent piping may be short radius fittings. Minimum size piping shall be 2 inches for buried piping and 1.5 inches for aboveground piping.
  1. Aboveground Piping:
    - a. Copper Tubing: ASTM B306, with ANSI B16.23, ANSI B16.29, or ANSI B16.32 solder joint fittings using ASTM B32, 95 5 tin antimony or Grade Sn96 tin silver solder, and flux containing not more than 0.2 percent lead.
  2. Cleanouts: ANSI A112.36.2M; provide threaded bronze or thermoplastic cleanout plugs.
    - a. Floor Cleanouts: Provide cast iron floor cleanout with flange, adjustable height polished bronze or nickel bronze rim and scoriated floor plate with "CO" cast in the plate, and countersunk screws for installing floor plate flush with finished floor.

- b. Wall Cleanouts: Provide polished stainless steel or chromium plated bronze cover plate and secure to cleanout plug with countersunk screw.
- 3. Drains: ANSI A112.21.1M; provide cast iron drains and clamping rings for use with membrane waterproofing.
  - a. Flush Strainer Floor Drains: Provide with double drainage flange, perforated or slotted cast bronze or nickel bronze strainer, adjustable collar, and P trap. Drains of sizes 2, 3, and 4 inches shall have strainers with minimum free drainage area of 5, 11, and 18 square inches, respectively.
  - b. Shower Floor Drains: Provide as specified for flush strainer floor drains, except that PVC drains may be provided for fiberglass shower stalls where fire separation requirements are not violated.
  - c. Extended Rim Floor Drains: Provide as specified for flush strainer floor drains, except strainer body shall have 1 inch extended rim installed flush with finished floor.

## 2.02 MISCELLANEOUS PIPING MATERIALS

- A. Pipe Nipples: ANSI B16, copper alloy for use in copper tubing and hot dip galvanized Schedule 80 steel pipe for use in steel piping.
- B. Unions: ANSI B16 for use in copper tubing; ANSI B16.39 hot dip galvanized steel for use in steel piping.
- C. Flanges: ANSI B16.1, Class 125, for use in ferrous piping; ANSI B16.22 or ANSI B16.24 for use in copper tubing; with full face flat type synthetic rubber gaskets.
- D. Escutcheon Plates: One piece or split hinge type metal plates for piping passing through floors, walls, and ceilings in exposed spaces, chromium plated finish on plates in finished spaces, paint finish on plates in unfinished spaces, and with setscrews or other approved positive means to anchor plates in place securely.
- E. Pipe Sleeves:
  - 1. Sleeves in Masonry and Concrete Walls, Floors, and Roofs: ASTM A53 or ASTM A120, Schedule 40 or Standard Weight, hot dip galvanized steel pipe sleeves.
  - 2. Sleeves in Partitions and Other Than Masonry and Concrete Walls, Floors, and Roofs: Hot dip galvanized steel sheet having a nominal weight of not less than 0.90 pounds per square foot.
- F. Pipe Hangers and Supports: Provide MSS SP 58 and MSS SP 69, Type 1 or 6, of the adjustable type, except as modified herein or indicated otherwise. Attachments to steel W or S beams shall be with Type 21, 28, 29, or 30 clamps. Attachments to steel angles and channels (with web vertical) shall be with Type 20 clamp with a beam clamp channel adaptor. Attachments to steel channel web



horizontal) shall be with drilled hole on center line and double nut and washer. Attachments to concrete shall be with Type 18 insert or a drilled hole with expansion anchor. Attachments to wood shall be as indicated. Hanger rods and attachments shall be full size of the hanger threaded diameter. Provide Type 40 insulation protection shields for insulated piping. Provide steel support rods. Provide nonmetallic, hair felt, or plastic piping isolators between copper tubing and the hangers.

- G. Access Doors: Provide 12 by 12 inch factory prefabricated and primed flush face steel access doors including steel door frame with continuous hinges and turn screw operated latch. Door frame shall be for installation in plaster and masonry walls. Furnish doors under this Section to provide proper access to concealed valves; install doors under the appropriate section of this Specification.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Installation of sanitary waste and vent systems including equipment, materials, and workmanship shall be in accordance with the Plumbing Code of New York State, except as modified herein. Plastic piping shall not penetrate fire walls or fire floors and shall be used on one side of fire walls and fire floors not closer than 6 inches to the penetration.
  - 1. Threaded Connections: Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil; apply only on male threads.
  - 2. Solder End Valves: Remove stems and washers and other item subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering.
  - 3. Pipe Supports (Hangers): Provide additional supports at the concentrated loads in piping between supports, such as for in-line water pumps and flanged valves.
  - 4. Maximum Spacing Between Supports:
    - a. Vertical Piping: Support metal piping at each floor, but at not more than 10 foot intervals. Support plastic at each floor and at midpoint between floors, but at not more than 5 foot intervals.
    - b. Horizontal Piping: Support cast iron piping at 5 foot intervals, except for pipe exceeding 5 foot length, provide supports at intervals equal to the pipe length but not exceeding 10 feet. Support plastic and glass piping at 4 foot intervals and support plastic piping at each change of direction. Support steel piping and copper tubing as follows:

MAXIMUM SPACING (FEET)						
Nominal Pipe Size (Inches)	One and Under	1.25	1.5	2	2.5	3 and Over
Steel Pipe	7	8	9	10	11	12
Copper Tube	6	6	8	8	9	10

5. Installation of Pipe Sleeves: Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25 inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation, and calk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material. Extend sleeves in floor slabs 3 inches above the finished floor, except sleeves are not required where DWV piping passes through concrete floor slabs located on grade.

### 3.02 NAMEPLATES

- A. Provide laminated plastic nameplates for equipment and valves. Laminated plastic shall be 0.125 inch thick melamine plastic, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information.
  1. Manufacturer, type, and model number
  2. Contract number and accepted date
  3. Capacity or size
  4. System in which installed
  5. System which it controls

### 3.03 FIELD TESTING

- A. Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the following tests in addition to the tests specified in the Plumbing Code of New York State, except as modified herein. Correct all defects in the work provided by the Contractor, and

repeat the tests until the work is in compliance with contract requirements.  
Furnish water, electricity, instruments, connecting devices, and personnel for the tests.

1. DWV Piping: Before the installation of fixtures, cap the ends of each system, fill the piping with water to the roof, and allow to stand a minimum of 3F hours with no measurable leakage. If the system is tested in sections, each opening shall be plugged and each section tested with not less than a 10 foot head of water.

END OF SECTION

## SECTION 22 42 00

### COMMERCIAL PLUMBING FIXTURES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Commercial Plumbing Fixtures, as shown on the Plans, as specified and/or directed.
- B. Related work specified elsewhere:
  - 1. Section 22 00 00 – Plumbing General Requirements
  - 2. Section 22 07 00 – Plumbing Insulation
  - 3. Section 22 11 16 – Domestic Water Piping
  - 4. Section 22 13 16 – Sanitary Waste and Vent Piping
  - 5. Division 26 – Electrical

##### 1.02 REFERENCE STANDARDS

- A. The following is a list of standards that may be referenced in this Section:
  - 1. American National Standards Institute (ANSI) Publication:
    - a. Z124.1 – Plastic Bathtub Units
    - b. Z124.2 – Gel Coated Glass Fiber Reinforced Polyester Resin Shower Receptors and Shower Stall Units
    - c. Z358.1 – Emergency Eye Wash and Shower Equipment
  - 2. American Society of Mechanical Engineers (ASME) Publication:
    - a. A112.6.1M – Supports for Off the Floor Plumbing Fixtures for Public Use
    - b. A112.6.2 – Framing-Affixed Supports (Carriers) for Off-the-Floor Plumbing Fixtures
    - c. A112.18.1 – Plumbing Supply Fittings
    - d. A112.18.2 – Plumbing Waste Fittings
    - e. A112.19.1 – Enameled Cast Iron Plumbing Fixtures
    - f. A112.19.2 – Ceramic Plumbing Fixtures
    - g. A112.19.3 – Stainless Steel Plumbing Fixtures
    - h. A112.19.4M – Porcelain Enameled Formed Steel Plumbing Fixtures
    - i. A112.19.5 – Flush Valves and Spuds for Water Closet Bowls, Tanks, and Urinals
    - j. A112.19.14 – Six Liter Water Closets Equipped with a Dual Flushing Device

3. American Society of Sanitary Engineering (ASSE) Publication:
  - a. 1001 – Atmospheric Type Vacuum Breakers
  - b. 1016 – Individual Thermostatic, Pressure Balancing and Combination Balancing and Thermostatic Control Valves for Individual Fixture Fittings
  - c. 1037 – Pressurized Flushing Devices for Plumbing Fixtures
  - d. 1070 – Water Temperature Limiting Devices
4. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Publication:
  - a. 18 – Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration
5. National Electrical Manufacturers Association (NEMA) Publication:
  - a. ICS 6 – Industrial Control and Systems: Enclosures
6. NSF International (NSF) Publication:
  - a. 61 – Drinking Water System Components – Health Effects
  - b. 372 – Drinking Water System Components – Lead Content
7. Underwriters Laboratories, Inc. (UL) Publication:
  - a. 399 – Drinking-Water Coolers
8. Uniform Fire Prevention and Building Code of New York State Publication:
  - a. 2020 – New York State Plumbing Code
  - b. 2020 – New York State Energy Conservation Code

### 1.03 GENERAL REQUIREMENTS

- A. Section 22 00 00, "Plumbing General Requirements", applies to this Section, with the additions and modifications specified herein. Plumbing systems including equipment, materials, installation, and workmanship shall be in accordance with the New York State Plumbing Code and New York State Energy Conservation Code, except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears.

### 1.04 SUBMITTALS

- A. Manufacturer's Data:
  1. Plumbing Fixtures
- B. Certificates of Conformance:
  1. Water flushing volume of flushometer and water closet combination
  2. Water flushing volume of flushometer and urinal combination

## PART 2 - PRODUCTS

### 2.01 FIXTURES, FITTINGS, ACCESSORIES, AND SUPPLIES:

- A. Provide control stop valves in each supply to each fixture. The finish of fittings, accessories, and supplies exposed to view shall be chromium plated per ASME A112.18.1. Center set faucets shall be top mounted with inlets on not greater than 4 inch centers, unless noted otherwise.
1. Flush Valve Type Water Closets (P-1): ASME A112.19.2, white vitreous china, wall hung, wall outlet, siphon jet, elongated bowl, white solid plastic elongated open front seat, and ASME A112.19.5 trim. Provide ASSE 1037, ADA-compliant electronic sensor exposed flush valve with infrared sensor, multiple-focused sensing fields, chrome plated cast brass, line powered with 6 VAC step down transformer and override button, including adjustable tailpiece, Chloramine-resistant EPDM Seals, vacuum breaker and angle (control stop) valve with vandal-resistant cap and back check. The water flushing volume of the flush valve and water closet combination shall not exceed 1.3 gallons per flush from 25 to 90 psi; furnish water closet manufacturer's certification of conformance. Provide ASME A112.6.2 water closet carrier. Manufacture of fixture shall be as by American Standard Afwall Model 3351.101, or approved equal.
  2. Flush Valve Type Urinals (P-2): ASME A112.19.2, white vitreous china, wall mounted, wall outlet, washout flush action, integral trap, extended side shields, and ASME A112.19.5 trim. Provide electronic sensor exposed flush valve with infrared sensor, multiple-focused sensing fields, chrome plated cast brass, line powered with 6 VAC step down transformer and override button, including adjustable tailpiece, Chloramine-resistant EPDM Seals, vacuum breaker and angle (control stop) valve with back check. The water flushing volume of the flush valve and urinal combination shall not exceed 0.5 gallons per flush from 20 to 80 psi. Furnish urinal manufacturer's certification of conformance. Manufacture shall be as by American Standard Washbrook Model 6590.001, or approved equal.
  3. Countertop Lavatories (P-3): Provide ASME 112.18.1 copper alloy center set faucets metering type ADA compliant faucet with 0.25 gallon per metering cycle, pressure compensating stationary spout, replaceable valve cartridge and an adjustable flow cycle solid brass construction, single-post mounting, vandal resistant, UL approved electronic faucet with proximity operation, solenoid valve, above-deck manual temperature control valve, flexible stainless steel hoses with check valves, filter screen and compression fittings, hard-wired with low voltage transformer. Faucet shall have a maximum flow rate of 0.5 gpm with vandal-resistant aerator. Provide with perforated grid strainer drain fittings, and 1.25 inch adjustable P traps. Furnish template and mounting kit by lavatory manufacturer. Faucet manufacture shall be as by American StandardNextGen Selectronic, or approved equal.

4. Counter Top Kitchen Sinks (P-4): ASME A112.19.3, 18 gauge stainless steel with integral mounting rim, top-mounted, minimum dimensions of 28 inches wide by 21 inches front to rear by 10 inches deep, single compartment with ledge back and undersides coated with sound dampening material. Provide top mounted ASME A112.18.1 copper alloy faucets, 2.2 GPM swing spout with aerator, ADA compliant lever handles, and stainless steel drain outlets with cup strainers. Provide 1.5 inch adjustable P trap with drain piping to vertical vent stack. Manufacture shall be as by Elkay Lustertone DLR, or approved equal. Faucet and strainer shall be as manufactured by Elkay Model LK810AT08L2 and Model LK35, or approved equal.
5. Electric Water Cooler (P -5): ASHRAE 18, ASME A112.19.3, ADA compliant Dual wall-mounted bubbler style with air-cooled condensing unit, 8.0 gph minimum capacity, stainless steel splash receptor, and all stainless steel cabinet, with 27-inch minimum knee clearance from front to bottom of unit to floor and 36-inch maximum spout height above floor. Bubblers shall also be controlled by push levers, by push bars, or touch pads one on each side or one on front and both sides of the cabinet. Manufacture shall be as by Elkay Model EZH20 LZOTL8WSSK, or approved equal.
6. Shower Stall Units (P-6): ANSI Z124.2, ADA compliant barrier free white plastic or gel-coated fiberglass above floor rough version receptor with slip resistant bathing surfaces and three walls integrally molded in one piece or made in sections for field assembly to fit 38-inch x 38-inch opening and ½-inch threshold. Provide horizontal L-shaped stainless steel grab bar, vertical stainless steel assist grab bar, L-shaped fold-up seat and stainless steel curtain rod. Provide brass body shower drains with nickel bronze perforated grid strainers and 2 inch adjustable P trap. Provide ASME A112.18.1, ball joint, self-cleaning adjustable spray pattern, hand held shower system kit with 2.5 gpm maximum flow controlled fixed hand shower head, 30-inch wall slide bar, in-line vacuum breaker, 60-inch metal hose, adjustable hot limit safety stop, connected to concealed pipe connected to copper alloy single lever pressure balance type mixing valve cartridge with front access integral screwdriver stops. Anchor the mixing valves and the pipe to the shower head in wall to prevent movement. Shower stall shall be as manufactured by Everfab S3839A, or equal. Shower faucet system and mixing valve shall be as manufactured by American Standard, Model 1662.221, or equal.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Installation of plumbing systems including fixtures, equipment, materials, and workmanship shall be in accordance with the New York State Plumbing Code,

except as modified herein. When fixtures require both hot water and cold water supplies, provide the hot water supply to the left of the cold water supply. Plastic piping shall not penetrate fire walls or fire floors and shall be used on one side of fire walls and fire floors not closer than 6 inches to the penetration.

1. Threaded Connections: Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil; apply only on male threads.
2. Solder End Valves: Remove stems and washers and other item subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering.
3. Pipe Supports (Hangers): Provide additional supports at the concentrated loads in piping between supports, such as for in-line water pumps and flanged valves.

### 3.02 NAMEPLATES

- A. Provide laminated plastic nameplates for equipment, gauges, thermometers, and valves; stop valves in supplies to fixtures will not require nameplates. Laminated plastic shall be 0.125 inch thick melamine plastic, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information.

1. Manufacturer, type, and model number
2. Contract number and accepted date
3. Capacity or size
4. System in which installed
5. System which it controls

### 3.03 FIELD TESTING

- A. Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Correct all defects in the work provided by the Contractor, and repeat the tests until the work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for the tests.

END OF SECTION



## SECTION 23 05 00

### MECHANICAL GENERAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Mechanical General Requirements, as shown on the Plans, as specified and/or directed.
- B. Related work specified elsewhere:
  - 1. Division 1, "General Requirements"
  - 2. Division 22, "Plumbing"
  - 3. Division 23, "Mechanical"
  - 4. Division 26, "Electrical"

##### 1.02 REFERENCE STANDARDS

- A. The following is a list of standards that may be referenced in this section:
  - 1. Code of Federal Regulations (CFR) Publications:
    - a. 29-1910 SUBPART O - Machinery and Machine Guarding
    - b. 29-1910.219 - Mechanical Power Transmission Apparatus

##### 1.03 SUBMITTALS

- A. Submit shop drawings, manufacturer's data, publication compliance, certified test reports, and manufacturer's certificates of compliance for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and have them approved before procurement, fabrication or delivery of the items to the job site. Shop drawings shall be accompanied by a letter of transmittal in duplicate, and all shop drawings shall be suitably identified with the name of the project, contract number, Contractor's name, date and initials indicating approval of such submittal by the Contractor under the applicable specification. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and the specific technical paragraph reference which specifies each item, applicable industry and technical society publication references, and other information necessary to establish contract compliance of each item to be furnished.
  - 1. Manufacturer's Data: Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.

2. Shop Drawings: Drawings shall be a minimum of 8.5 inches by 11 inches in size, except as specified otherwise. Drawings shall include floor plans, sectional views, wiring diagrams, and installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
  3. Manufacturer's Certificates of Compliance: Submit certification from manufacturer attesting that materials and equipment to be furnished for this project comply with the requirements of this specification and of the reference publications. Pre-printed certifications will not be acceptable; certifications shall be the manufacturer's original; certifications shall be not more than one year old. The certification shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; "equal or exceed the service and performance of the specified material". The certification shall simply state that the product conforms to the requirements specified. Certificates shall be signed by the manufacturer's official authorized to sign certificates of compliance.
  4. Reference Standards Compliance: Where equipment or materials are specified to conform to industry and technical society reference standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), American Society of Mechanical Engineers (ASME), American Gas Association (AGA), American Refrigeration Institute (ARI), and Underwriters' Laboratories (UL), proof of such conformance shall be submitted. If an organization uses a label or listing to indicate compliance with a particular reference standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections.
- B. Independent Testing Organization Certificate: In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing and approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

#### 1.04 OPERATION AND MAINTENANCE MANUAL

- A. Furnish an operation and maintenance manual for each item of equipment. Furnish three copies of the manual bound in hardback binders or an approved equivalent. Furnish one complete manual to the Owner's Representative for

review and approval not more than 90 calendar days after an item is approved, but at least 60 calendar days prior to field acceptance testing of the item. Furnish the remaining manuals at least 60 days prior to contract completion. Inscribe the following identification on the cover: the words "OPERATION AND MAINTENANCE MANUAL", the name and location of the equipment or the building, the name of the Contractor, and the contract number. The manual shall include the names, addresses, and telephone numbers of each subcontractor installing equipment, and of the local representatives for each item of equipment. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start up, operation and shut down; description of the function of each principal item of equipment; the procedure for starting; the procedure for operating; shut down instructions; installation instructions; maintenance instructions; lubrication schedule including type, grade, temperature range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts lists for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the project site. The manual shall be complete in all respects for equipment, controls, accessories, and associated appurtenances provided.

#### 1.05 CATALOGED PRODUCTS

- A. Materials and equipment shall be cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturer's latest design that complies with the specification requirements. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the items need not be the products of the same manufacturer. Each item of equipment shall have the manufacturer's name, address, model number and serial number on the nameplate securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

#### 1.06 MANUFACTURER'S RECOMMENDATIONS

- A. Unless otherwise stated in the Contract Specifications, all new equipment items, and specialties shall be installed in strict accordance with the recommendations of the manufacturer of the items being installed. Prior to the installation of new items, the Contractor shall submit to the Owner's representative printed copies of the manufacturer's installation recommendations. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material. Failure to

install items in accordance with manufacturer's recommendations can be cause for rejection of the work items installed.

#### 1.07 LAYOUT OF THE WORK

- A. Coordinate the proper relation of the work to the building structure, existing utilities and to the work of all trades. The Contractor shall advise the Owner's Representative of any discrepancy before performing any work.
  - 1. Contract Drawings: The Contract Drawings represent the general intent as to piping and equipment arrangements. All locations and dimensions shown shall be field verified and minor alterations made if so required. Where dimensions are not given for the location and arrangement of mechanical systems, locations may be assumed to be approximate, and may be altered if required. Major modifications to the indicated arrangements shall be approved by the Owner's Representative prior to the installation of mechanical systems. Schematic diagrams represent the overall system requirements and do not necessarily indicate the physical orientation, location or dimensions of that system.
  - 2. Record Drawings: The Contractor shall maintain a record of the progress of the work and shall submit three (3) sets of As-Built Drawings upon completion of the project.

#### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Properly store, adequately protect, and carefully handle equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Engineer. Replace damaged or defective items.

#### 1.09 SAFETY REQUIREMENTS

- A. Equipment Safety: Fully enclose or properly guard in accordance with 29 CFR 1910.219 belts, pulleys, chains, gears, couplings, projecting setscrews, keys, rotating parts, and other power transmission apparatus, located where persons can come in close proximity thereto. Points of operation, ingoing nip points, and machinery producing flying chips and sparks shall be guarded in accordance with the applicable portions of 29 CFR 1910 SUBPART O. Provide positive means of locking out equipment so that equipment cannot be accidentally started during maintenance procedures. High temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of the type specified. Provide catwalks, maintenance platforms, and guardrails where required for safe operation and maintenance of equipment. Provide ladders or stairways to reach catwalks and maintenance platforms. Ensure that access openings leading to equipment are large enough to carry through routine maintenance items such as filters and tools.

## 1.10 ELECTRICAL REQUIREMENTS

- A. Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Division 26-Electrical. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under this Section. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Division 26 – Electrical. Unless specifically noted otherwise, all control wiring (120 volt or less) shall be provided by Mechanical Contractor and conform to the requirements of Division 26-Electrical.

## 1.11 INSTRUCTION TO OWNER'S PERSONNEL

- A. When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Owner's personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The number of days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the Contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

## 1.12 INSPECTIONS AND CERTIFICATIONS

- A. The Contractor shall provide and pay for any third party inspections or certifications required by applicable regulatory agencies for boilers and other mechanical equipment components modified, or furnished and installed as a part of the Contract work.

## PART 2 - PRODUCTS

NOT USED

## PART 3 - EXECUTION

### 3.01 FIELD PAINTING

#### A. Painting of New Equipment:

1. Equipment painting, factory applied or shop applied, shall be as specified herein, and provided under each individual section of this Specification.
  - a. Factory Painting Systems: Manufacturer's standard factory painting systems may be provided.
  - b. Shop Painting Systems: Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces shall not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees Fahrenheit (F) shall be cleaned to bare metal. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.
  - c. Metal Surfaces Subject to Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.
  - d. Metal Surfaces Subject to Temperatures Between 120 and 400 Degrees F: Surfaces shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.
  - e. Metal Surfaces Subject to Temperatures Greater Than 400 Degrees F: Surfaces shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

END OF SECTION

## SECTION 23 05 93

### TESTING AND BALANCING AIR AND WATER SYSTEMS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Testing and Balancing Air and Water Systems as shown on the Plans, as specified, and/or directed.
- B. Related work specified elsewhere:
  - 1. Division 1 – General Requirements
  - 2. Division 23 – Mechanical

##### 1.02 REFERENCE STANDARDS

- A. The following is a list of standards that may be referenced in this section:
  - 1. Associated Air Balance Council (AABC) Publication:
    - a. National Standards for Total System Balance (NSFTSB)
  - 2. National Environmental Balancing Bureau (NEBB) Publication:
    - a. Procedural Standards for Testing-Adjusting-Balancing of Environmental Systems
  - 3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Publication:
    - a. ASHRAE Handbook of Fundamentals
  - 4. American National Standards Institute (ANSI) Publication:
    - a. S1.4 - Specification for Sound Level Meters
    - b. S1.11 - Specifications for Octave and Third-Octave Band Filter Sets

##### 1.03 DEFINITIONS

- A. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment, (e.g., reduce fan speed, throttling, etc.)
- B. Procedure: Standardize approach and execution of sequence of work operations to yield reproducible results.
- C. Report Forms: Test data sheets arranged for collection of test data in logical order to submission and review. This data should also form the permanent record which shall be used as the basis for any future testing, adjusting, and balancing required.
- D. Test: To determine quantitative performance of equipment.

#### 1.04 SUBMITTALS

- A. An agenda shall be submitted and approved by the Engineer prior to start of testing and balancing work. Include the following:
  - 1. General description of each air system with its associated equipment, and operation cycles for heating, intermediate and cooling. Where different cycles are used for day and night, they shall be described independently.
  - 2. A complete listing of all airflow and air terminal measurements to be performed.
  - 3. Proposed selection points for sound measurements. List shall include typical spaces and sound sensitive areas including specifically auditoriums and conference rooms.
  - 4. Specific test procedures and parameters for determining specified quantities; e.g., flow drafts, sound levels, etc., from the actual field measurements to establish compliance with Contract requirements.
  - 5. Samples of forms showing applications of procedures and calculations to typical systems.
- B. Standards Compliance:
  - 1. Testing Agency
  - 2. Testing Agency Personnel
  - 3. Professional Engineers
  - 4. Instrument Calibration
- C. Schedules:
  - 1. Testing Agenda
- D. Reports:
  - 1. Preliminary Report
  - 2. Certified Report

#### 1.05 TESTING AND BALANCING AGENCY

- A. Air and Water Systems Testing and Balancing: Upon completion of the installation and field testing performance test and adjust the supply, return, make-up, and exhaust air systems, and chilled and heating water systems to provide the air volume and water flow quantities indicated and sound levels required. Accomplish all work in accordance with the agenda and procedures specified and AABC NSFTSB and standards of the National Environmental Balancing Bureau (NEBB). Correct air and water system performance deficiencies disclosed by the test before balancing the systems.
- B. Agency Qualifications: The Contractor, as part of this Contract shall obtain the services of a qualified testing organization to perform the testing and balancing work as herein specified. Prior to commencing work under this Section of Specifications, the testing organization shall have been approved by the Engineer. The criteria for determining qualifications shall be membership in the Associated



Air Balance Council (AABC), or certification by the National Environmental Balancing Bureau.

- C. Owner Selection: If the Contractor fails to submit the name of an acceptable agency, the Engineer may select a firm to accomplish the work, and the selection shall be binding upon the Contractor at no additional cost to the Owner.

#### 1.06 TESTING AGENDA

- A. Preliminary Report: Review Plans and Specifications prior to installation of any of the affected system. Submit a written report to the Engineer indicating any deficiencies in the system that would preclude the proper adjusting, balancing, and testing of the systems.
- B. Procedure Reporting: Provide specific test procedures for measuring air quantities at terminals. Specify type of instrument to be used, method of instrument application (by sketch), and factors for:
  - 1. Air terminal configuration
  - 2. Flow direction (supply or exhaust)
  - 3. Velocity corrections
  - 4. Density corrections (unless applicable data are covered elsewhere)

#### 1.07 PROCEDURES AND INSTRUMENTS, GENERAL

- A. Requirements: Adjust systems and components thereof that perform as required by Drawings and Specifications.
- B. Test Duration: Operating tests of heating and cooling coils, fans and other equipment shall be of not less than four hours duration, after stabilized operating conditions have been established. Capacities shall be based on temperatures and air quantities measured during such tests.
- C. Instrumentation: Method of application of instrumentation shall be in accordance with the approved agenda. Furnish all personnel, instruments and equipment for tests specified herein.
  - 1. Accuracy of Instruments: Instruments used for measurements shall be accurate. Provide calibration histories for each instrument for examination. Calibrate each test instrument by an approved laboratory or by the manufacturer. The Engineer has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.
  - 2. Application of Instruments: Comply with manufacturer's certified instructions.
  - 3. Permanently-Installed Instruments: Do not install permanently-installed equipment used for the tests, e.g., gages, thermometers, etc., until just prior to the tests to avoid damage and changes in calibration.

4. Accuracy of All Thermometers: Plus or minus 1 graduation at the temperatures to be measured. Gradations shall conform with the following schedule:

<u>Medium</u>	<u>Design Temperature Differential (°F)</u>	<u>Maximum Graduation (°F)</u>
Air	10 or less	1/2
Air	over 10	1
Water	10 or less	1/10
Water	10-20	1/2
Water	over 20	1

## PART 2 - PRODUCTS

NOT USED

## PART 3 - EXECUTION

### 3.01 AIR SYSTEM PROCEDURES

- A. Adjustments: Adjust all air handling systems to provide the required design air quantity to, or through, each component. Conduct adjusting and balancing of systems during periods of the year approximating maximum seasonal operation.
- B. Equalizers: Adjust equalizing devices to provide uniform velocity across the inlets (duct side for supply of terminals, prior to measuring flow rates).
- C. Balance: Use flow adjusting (volume control) devices to balance air quantities only, i.e., proportion flow between various terminals comprising system, and only to the extent that their adjustments do not create objectionable air motion or sound, i.e., in excess of specified limits.
1. Balancing between runs (submains, branch mains and branches): Use flow regulating devices at, or in, the divided - flow fitting. Minimize restriction imposed by flow regulating devices in or at terminals.
  2. Final Measurements of Air Quantity: Make final measurements of air quantity, after the air terminal has been adjusted to provide the optimum air patterns of diffusion.
- D. Fan Adjustment: Total air system quantities, generally, shall be varied by adjustment of fan speeds, or axial-flow fan wheel blade pitch. For systems with direct-connected fans (without adjustable pitch blades), damper restrictions of a system's total flow may be used, only if system pressure is less than 1/2-inch w.g. and sound level criteria is met.

- E. Air Measurements and Balancing:
1. Pitot Tube: Except as specifically indicated herein, make pitot tube traverses of each duct to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform with the ASHRAE Handbook Fundamentals.
  2. Pitot Tube Traverse: Except for ducts serving modular office area with movable partitions, which are subject to change, pitot-tube traverse may be omitted if the duct serves only a single room or space and its design volume is less than 200 cfm. In lieu of pitot-tube traverse, determine airflow in the duct by totaling volume of individual terminals served, measured as described herein.
  3. Test Holes: Test holes, specified in Section entitled Ductwork and Accessories, shall be in a straight duct, as far as possible downstream from elbows, bends, take-offs, and other turbulence generating devices, to optimize reliability of flow measurements.
  4. Air Terminal Balancing: Measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, shall be used only for balancing. Measurement of air quantities at each type of air terminal (inlet and outlet) shall be determined by the method approved for balancing agenda. Conduct laboratory tests to prove accuracy of methodology when so directed by the Engineer. Perform such tests in conformance with ASHRAE Standards.
  5. Air Motion and Distribution: As indicated. The Contractor, in addition to air motion measurements, shall make smoke tests wherever requested by the Engineer, to demonstrate the air distribution from air terminals.

### 3.02 WATER SYSTEM PROCEDURES

- A. Adjustment: Adjust heating, cooling, and condensing water systems to provide required quantity to, or through each component.
- B. Metering: Measure water quantities and pressures with calibrated meters.
- C. Water Measurements and Balancing: Use venturi tubes, orifices, or other metering fittings and pressure gages. Adjust systems to provide the approved pressure drops through the heat transfer equipment (coils (except room units), converters, etc.), prior to the capacity testing. Where flow metering fittings are not installed, determine flow balance by measuring temperature differential across the heat transfer equipment. Perform measurement of temperature differential with the air system, adjusted as described herein, in operation.
- D. Automatic Controls: Position automatic control valves for full flow through the heat transfer equipment of the system during tests.
- E. Flow: Flow through bypass circuits at three-way valves shall be adjusted to balance that through the supply circuit.

- F. Distribution: Adjust distribution by means of balancing devices (cocks, valves and fittings) and automatic flow control valves. Do not use service valves for adjustment. Where automatic flow control valves are utilized in lieu of venturi tubes, record only pressure drop across the valve if said pressure drop is within the pressure drop rating on the valve tag.

### 3.03 SOUND TEST PROCEDURES

- A. General: Tests to demonstrate compliance with sound requirements shall be made at each selection point included in the agenda.
- B. Timing: Take sound level measurements at times when the building is unoccupied, or when activity in surrounding areas and background noise levels in areas tested are at minimum and relatively free from sudden changes in noise levels. Take measurements with all equipment secured, except that being tested. Measure sound levels at any point within a room not less than 6 feet from an air terminal or room unit, and not closer than 3 feet from any floor, wall, or ceiling surface.
- C. Meters: Measure sound levels with a sound meter complying with the latest ANSI S1.4. Use the "A" scale to measure overall sound levels. To determine the specified octave band levels, the above sound levels meter, set on "C" scale, shall be supplemented by an Octave Band Analyzer complying with ANSI S1.11.
- D. Equipment Components: Determine "equipment components" of room sound (noise) levels for each (of eight) octave bands as follows:
1. Measure room sound pressure level "LPb" with equipment to be tested shut off.
  2. Measure room sound pressure level "LPt" with equipment to be tested turned on.
  3. Calculate LPt-LPb; if this value is less than 1, applicable test must be rerun with lower background level (LPb) unless LPt is within sound pressure level specified for equipment.
  4. Determine "C" from table below:

<u>Lpt-LPb (dB)</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4-4-1/2</u>	<u>5-5-1/2</u>	<u>6-7-1/2</u>	<u>8-12</u>	<u>Over 12</u>
C	7	4	3	2	1-1/2	1	1/2	O

5. The "equipment component" of room sound level equals LPt-c.

### 3.04 REPORTS

- A. Submittal: Submit three copies of the reports described herein, covering air and water system performance air motion (fpm), and sound pressure levels, to the Engineer prior to final tests and inspection.

- B. Instrument Records: Include types, serial numbers, and dates calibration of all instruments.
- C. Reports: Reports shall identify conspicuously items not conforming to contract requirements, or obvious mal-operation and design deficiencies.
- D. Certification: The reports shall be certified by an independent Registered Professional Engineer who is versed in the field of air and water balancing and who is not affiliated with any firm involved in the design or construction phases of the project. Certification shall include checking or adherence to agenda, of calculations, of procedures, and evaluation of final summaries.

### 3.05 AIR SYSTEM DATA

- A. The certified report shall include for each air-handling system the data listed below:
  - 1. Equipment (fan or factory-fabricated station unit):
    - a. Installation Data:
      - 1) Manufacturer and Model
      - 2) Size
      - 3) Arrangement, Discharge, and Class
      - 4) Motor H.P., Voltage, Phase, Cycles, and Full Load Amps
      - 5) Location and Local Identification Data
    - b. Design data: Data listed in schedules on Drawings and Specifications.
    - c. Fan Recorded (Test) Data:
      - 1) C.F.M.
      - 2) Static Pressure
      - 3) R.P.M.
      - 4) Motor Operating Amps
      - 5) Motor Operating B.H.P.
  - 2. Duct Systems:
    - a. Duct Air Quantities (Maximum and Minimum) - Main, Submains, Branches, Outdoor (Outside) Air, Total-air, and Exhaust
    - b. Individual Air Terminals:
      - 1) Terminal Identification (Supply or Exhaust Location and Number Designation)
      - 2) Type Size, Manufacturer and Catalog Identification
      - 3) Design and Recorded Quantities - C.F.M.
      - 4) Deflector Vane or Diffusion Cone Settings
      - 5) Applicable Factor for Application, Velocity, Area, etc.
      - 6) Design and Recorded Velocities - F.P.M. (State "core", "inlet", etc., as applicable)

### 3.06 SOUND LEVEL DATA

- A. Report: Record data on sound levels taken at each selected location, as follows:
  - 1. Source of sound and location.
  - 2. Diagram or description of relationship of sound source to measuring instrument.
  - 3. "A" scale readings:
    - a. Equipment being tested turned off (ambient)
    - b. Equipment being tested turned on (operating conditions)
  - 4. Reading at each specified octave band frequency:
    - a. Equipment being tested turned off (ambient)
    - b. Equipment being tested turned on (operating condition)
  - 5. "Equipment components" of sound (noise) levels with applicable calculations per "Sound Test Procedure".
  - 6. Graph showing relationship between pressure levels specified and recorded readings.
- B. Retest: Subsequent to any correctional construction work, such as acoustic corrections, make measurements to verify that associated air and water quantities, as previously measured, have not been disrupted.
- C. Certified Report; Record all sound data, and their locations, after final adjustments or air and water systems involved.

### 3.07 FIELD TEST

- A. General: Make tests to demonstrate that capacities and general performance of air systems comply with Contract requirements.
  - 1. Final Inspection; At the time of final inspection, the Contractor shall recheck, in the presence of the Engineer, random selections of data air quantities, air motion and sound levels recorded in the Certified Report.
  - 2. Points and areas for recheck: As selected by the Engineer.
  - 3. Measurement and Test Procedures: As approved for work forming basis of Certified Report.
  - 4. Selections for Recheck (Specific Plus Random): In general, selections for recheck will not exceed 25 percent of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.
- B. Retests: If random tests elicit a measured flow deviation of ten percent or more from, or a sound level of 2 Db or more greater than that recorded in the Certified Report listings, at ten percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, new Certified Reports submitted, and new inspection tests made.

- C. Marking of Settings: Following final acceptance of Certified Reports by the Owner, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the Contractor, so that adjustment can be restored if disturbed at any time. Do not mark devices until after final acceptance.

END OF SECTION

## SECTION 23 07 00

### HVAC INSULATION

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for HVAC Insulation as shown on the Plans, as specified and/or directed.
- B. Related work specified elsewhere:
  - 1. Section 23 05 00 – Mechanical General Requirements
  - 2. Section 23 31 13 – Ductwork and Ductwork Accessories

##### 1.02 REFERENCE STANDARDS

- A. The following is a list of standards that may be referenced in this section:
  - 1. American Society for Testing and Materials (ASTM) Publication:
    - a. A167 - Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and Strip
    - b. C177 - Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus, Test Method
    - c. C195 - Mineral Fiber Thermal Insulating Cement
    - d. C533 - Calcium Silicate Block and Pipe Thermal Insulation
    - e. C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
    - f. C547 - Mineral Fiber Pipe Insulation
    - g. C552 - Cellular Glass Thermal Insulation
    - h. C553 - Mineral Fiber Blanket and Felt Insulation for Commercial and Industrial Applications
    - i. C592 - Mineral Fiber Blanket Insulation and Blanket Type Pipe Insulation (Metal Mesh Covered) (Industrial Type)
    - j. C612 - Mineral Fiber Block and Board Thermal Insulation
    - k. C795 - Thermal Insulation for Use in Contact with Austenitic Stainless Steel
    - l. C916 - Adhesives for Duct Thermal Insulation
    - m. C921 - Properties of Jacketing Materials for Thermal Insulation
    - n. D227 - Coal Tar Saturated Organic Felt Used in Roofing and Waterproofing
    - o. E84 - Surface Burning Characteristics of Building Materials
    - p. E96 - Water Vapor Transmission of Materials



2. Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS) Publication:
  - a. SP58 - Pipe Hangers and Supports Materials, Design, and Manufacture
  - b. SP69 - Pipe Hangers and Supports Selection and Application
3. National Fire Protection Association (NFPA) Publication:
  - a. 255 - Surface Burning Characteristics of Building Materials
4. Underwriters Laboratories, Inc. (UL) Publication:
  - a. 723 - Tests for Surface Burning Characteristics of Building Materials
5. Uniform Fire Prevention and Building Code of New York State Publication:
  - a. 2020 Energy Conservation Construction Code

### 1.03 SUBMITTALS

- A. Manufacturer's Data:
  1. Insulation
  2. Jackets
  3. Casings
  4. Vapor barrier materials
  5. Accessory materials
- B. Standards Compliant: Standards compliance labels are required on each container or package:
  1. Insulation
  2. Jackets
  3. Casings
  4. Vapor barrier materials
  5. Accessory materials

### 1.04 DEFINITIONS

- A. Finished Spaces: Spaces used for habitation or occupancy where rough surfaces are plastered, paneled, or otherwise treated to provide a pleasing appearance.
- B. Unfinished Spaces: Spaces used for storage or work areas where appearance is not a factor, such as unexcavated spaces and crawl space.
- C. Concealed Spaces: Spaces out of sight. For example, above ceilings; below floors; between double walls; furred in areas; pipe and duct shafts; and similar spaces.
- D. Exposed: Open to view. For example, pipe running through a room and not covered by other construction.

- E. Fugitive Treatments: Treatments subject to deterioration due to aging, moisture, high humidity, oxygen, ozone, and heat. Fugitive materials are entrapped materials that can cause deterioration, such as solvents and water vapor.
- F. Outside: Open to view up to 5 feet beyond the exterior side of walls, above the roof, and unexcavated or crawl spaces.

#### 1.05 MANUFACTURER'S STAMP OR LABEL

- A. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to the project site for use must have the manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material. Insulation packages and containers shall be asbestos free.

#### 1.06 FLAME SPREAD AND SMOKE DEVELOPED RATINGS

- A. In accordance with NFPA 255, ASTM E84 or UL 723, the materials shall have a flame spread rating of not more than 25 and a smoke developed rating of not more than 50.
  - 1. Materials Tests: Test factory applied materials as assembled. Field applied materials may be tested individually. Use no fugitive or corrosive treatments to impart flame resistance. UL label or satisfactory certified test report from a testing laboratory will be required to indicate that fire hazard ratings for materials proposed for use do not exceed those specified. Flame proofing treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.
  - 2. Materials Exempt From Fire Resistant Rating: Nylon anchors.
  - 3. Materials Exempt from Fire Resistant Rating When Installed In Outside Locations, Buried, or Encased In Concrete: PVC casing and glass fiber reinforced plastic casing.

### PART 2 - PRODUCTS

#### 2.01 PIPING SYSTEMS INSULATION

- A. Piping systems (except buried pipe) requiring insulation, types of insulation required, and insulation thickness shall be as listed in Tables I and II herein. Except for flexible unicellular insulation, insulation thicknesses as specified in Table II shall be one inch greater for insulated piping systems located outside. Unless otherwise specified, insulate all fittings, flanges, and valves, except valve stems, hand wheels, and operators. Use factory premolded, precut, or field fabricated insulation of the same thickness and conductivity as used on adjacent piping. Insulation exterior shall be factory cleanable, grease resistant, non-flaking and non-peeling. Pipe insulation shall conform to the referenced publications in Table I.

1. Flexible Unicellular Insulation: ASTM C534. The minimum density limit of 4.5 pounds per cubic foot may be waived if all other characteristics of the standard are met.
2. Wicking Type Insulation: ASTM C795. Use over austenitic stainless steel.
3. Piping Insulation Finishes:
  - a. All Purpose Jacket: Except calcium silicate and unicellular insulation, provide a factory applied all-purpose jacket with or without integral vapor barrier as required by the service. Provide jackets in exposed locations with a white surface suitable for field painting. Allow a maximum water vapor permeance of 0.05 perm per ASTM E96, a puncture resistance of not less than 50 Beach units, and a minimum tensile strength of 35 pounds force per inch of width.
  - b. Vapor Barrier Material: Resistant to flame, moisture penetration, and mold growth. Provide vapor barrier material on pipe insulation as required in Table I.

## 2.02 DUCTS (HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS (HVAC)) INSULATION

- A. Duct Insulation in Concealed Spaces: Two inch thick mineral fiber flexible resilient blanket insulation with a maximum insulation rating (installed) of R-6, and a maximum conductivity of 0.31 btu in/per hr sq. ft. degree F at 75 degrees F mean temperature as tested in accordance with ASTM C518.
- B. Duct Insulation Not in Concealed Spaces: Mineral fiber per ASTM C612, Class 2 (maximum surface temperature 400 degrees F), 3 pcf (pounds per cubic foot) average, 1-1/2 inch thick, inside the building, and a minimum insulation rating (installed) of R-6.
- C. Wicking Type Insulation: ASTM C795. Use over austenitic stainless steel surfaces.
- D. Insulation Thickness for All Types of Ductwork Located Outside: Provide insulation one inch thicker than specified herein.
- E. Acoustically Lined Ducts: For ductwork indicated or specified in Section 233113, "Ductwork and Accessories", to be acoustically lined, provide external insulation as specified in paragraph "Duct Insulation Not In Concealed Spaces".
- F. Duct Insulation Finishes:
  1. All Purpose Jacket: Provide a factory applied all-purpose jacket with or without integral vapor barrier as required by the service. Provide jackets in exposed locations with a white surface suitable for field painting. All purpose jacket shall have a maximum water vapor permeance of 0.05 perm per ASTM E96; a puncture resistance of not less than 50 Beach

units; and a tensile strength of not less than 35 pounds force per inch of width.

2. Vapor Barrier Material: Material shall be resistant to flame, moisture penetration, and shall not support mold growth. Provide vapor barrier on all HVAC duct insulation, on except insulation for heating only.

## 2.03 EQUIPMENT

- A. Insulate all equipment and accessories as specified in Table III. In outside locations, provide insulation one inch thicker than specified. Increase the specified insulation thickness for equipment only where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface. Additional insulation is not required for factory insulated equipment.

## 2.04 ADHESIVES, SEALANTS, AND COATING COMPOUNDS

- A. Adhesive for Securing Insulation to Metal Surfaces and Vapor Barrier Lap Adhesive (For Use in Building Interior Only): ASTM C916, Type I (an adhesive in which the vehicle is nonflammable in liquid (wet) state and which will pass the edge burning test), or Type II (An adhesive in which the vehicle is nonflammable in the liquid (wet) state and which will not pass the edge burning test).
- B. Mineral Fiber Insulation Cement: ASTM C195, thermal conductivity 0.85 maximum at 200 degrees F mean when tested per ASTM C177.
- C. Weatherproof Coating: For outside applications use a weatherproof coating recommended by the manufacturer of the insulation and jackets.

## 2.05 ACCESSORIES

- A. Staples: ASTM A167, Type 304stainless steel outside clinch type.
- B. Insulation Bands: 3/4 inch wide; 0.20-inch aluminum.
- C. Anchor Pins: Provide anchor pins and speed washers recommended by the insulation manufacturer.
- D. Glass Cloth and Tape: Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces per square yard. In lieu of glass cloth and tape, open weave glass membrane may be used.
- E. Coal Tar Saturated Organic Felt: ASTM D227, minimum weight of 13 pounds per 100 square feet.
- F. Wire: Soft annealed stainless steel, 0.047 inch nominal diameter.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Do not insulate materials until all system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust, and scale and dried. Insulate return ducts, outside air intakes and supply ducts to the room outlets, flexible runouts, plenums, casings, mixing boxes, filter boxes, coils, fans, and the portion of air terminals not in the conditioned spaces. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction with valve handle, safety relief, etc. Allow adequate space for pipe expansion. Conditioned space shall be defined as an area, room or space normally occupied and being heated or cooled for human habitation by any equipment. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Insulation shall be continuous through sleeves, wall and ceiling openings, except at fire dampers in duct systems. Extend all surface finishes to protect all surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer's recommended coverage per gallon. Individually insulate piping and ductwork. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during the application of any finish. Bevel and seal the edges of exposed insulation. Unless otherwise indicated, do not insulate the following:
1. Exposed air conditioning supply and return ducts in air conditioned space that furnish conditioned air 24 hours each day of the cooling season.
  2. Exposed heating supply and return ducts in spaces that are heated 24 hours each day of the heating season.
  3. Fibrous glass ductwork.
  4. Factory preinsulated flexible ductwork.
  5. Factory insulated ductwork, plenums, casings, mixing boxes, filter boxes.
  6. Vibration isolating connections.
  7. Adjacent insulation.
  8. ASME stamps.
  9. Fan name plates.
  10. Access plates in fan housings.

### 3.02 PIPING INSULATION

- A. Pipe Insulation (Except Unicellular Insulation): Installation of HVAC insulation including materials and workmanship shall be in accordance with the New York State Energy Conservation Construction Code, except as modified herein. Place sections of insulation around the pipe and joints tightly butted into place. The jacket laps shall be drawn tight and smooth. Secure jacket with fire resistant adhesive, factory applied self-sealing lap, or stainless steel outward

clinch staples spaced not over 4 inches on centers and 1/2 inch minimum from edge of lap. Cover circumferential joints with butt strips, not less than 3 inches wide, of material identical to the jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inches. Adhesive used to secure the butt strip shall be the same as used to secure the jacket laps. Apply staples to both edges of the butt strips. When a vapor barrier jacket is required, as indicated in TABLE I, or on the ends of sections of insulation that butt against flanges, unions, valves, and fittings, and joints, use a vapor barrier coating or manufacturer's weatherproof coating for outside service. Apply this vapor barrier coating at all longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend the patch not less than 1-1/2 inches past the break in both directions. At penetrations by pressure gauges and thermometers, fill the voids with the vapor barrier coating for outside service. Seal with a brush coat of the same coating. Do not use staples to secure jacket laps on pipes carrying fluid medium at temperatures below 35 degrees F. Where penetrating roofs, insulate piping to a point flush with the top of the flashing and seal with the vapor barrier coating. Butt tightly the exterior insulation to the top of the flashing and interior insulation. Extend the exterior metal jacket 2 inches down beyond the end of the insulation. Seal the flashing and counterflashing underneath with the vapor barrier coating. In cold water piping in high humidity areas, use cellular glass, or flexible unicellular insulation.

- B. Flexible Unicellular Insulation: Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90 degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral fiber insulation inserts and sheet metal sleeves. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Apply two coats of vinyl lacquer finish to flexible unicellular insulation in outside locations.
- C. Hangers and Anchors: Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by the insulation, provide MSS SP 58, Type 40 galvanized steel shields or MSS SP 58, Type 39 protection saddles conforming to MSS SP 69. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports. Insulation inserts shall be of cellular glass (minimum 8 pcf), molded glass fiber (minimum 8 pcf), or other approved material of the same thickness as adjacent insulation. Inserts shall have sufficient compressive strength to adequately support the pipe without compressing the inserts to a thickness less than the adjacent insulation. Insulation inserts shall cover the bottom half of the pipe circumference 180 degrees and be not less in length than the protection shield. Vapor barrier facing of the insert shall be of the same material as the facing on the adjacent insulation. Seal inserts into the insulation with vapor barrier coating, or for exterior work, manufacturers recommended weatherproof coating, as applicable. Where protection saddles are used, fill all voids with the same insulation material as used on the adjacent pipe.

- D. Sleeves and Wall Chases: Where penetrating interior walls, extend a metal jacket 2 inches out on either side of the wall and secure on each end with a band. Where penetrating floors, extend a metal jacket from a point below the back-up material to a point 10 inches above the floor with one band at the floor and one not more than one inch from end of metal jacket. Where penetrating exterior walls, extend the metal jackets through the sleeve to a point 2 inches beyond the interior surface of the wall.
- E. Flanges, Unions, Valves and Fittings Insulation (Except Flexible Unicellular) for Hot Piping: Factory fabricated removable and reusable insulation covers may be used. For inside high temperature hot water systems, heating hot water, and steam and condensate return systems, place factory premolded, precut or field fabricated segmented insulation of the same thickness and conductivity as the adjoining pipe insulation around the flange, union, valve, and fitting abutting the adjoining pipe insulation. If nesting size insulation is used, overlap 2 inches or one pipe diameter whichever is larger. Use insulating cement to fill voids. Elbows insulated using segments shall have not less than three segments per elbow. Place and joint the segments with manufacturer's recommended water vapor resistant, fire retardant, and adhesive appropriate for the temperature limit of the service. Upon completion of installation of insulation, apply two coats of lagging adhesive with glass tape embedded between coats. Overlap tape seams one inch. Extend adhesive onto adjoining insulation not less than two inches. The total dry film thickness shall be not less than 1/16 inch. Where unions are indicated not to be insulated, taper the insulation to the union at a 45 degree angle. Coat the insulation and all-purpose jacket with two coats of lagging adhesive and with glass tape embedded between coats. The total dry film thickness shall be not less than 1/16 inch. At the option of the Contractor, factory premolded one piece PVC fitting covers may be used in lieu of two coats of adhesive with tape embedded between coats. Factory premolded field fabricated segment or blanket insert insulation shall be used under the fitting covers. Install factory premolded one piece PVC fitting covers over the insulation and secure by stapling, taping with PVC vapor barrier tape, or with metal or plastic tacks made for securing PVC fitting covers. Do not use PVC fitting covers where exposed to the weather. Limit the use of PVC fitting covers to ambient temperatures below 150 degrees F.
- F. Flanges, Unions, Valves, Anchors, Fittings for Cold Piping: Factory fabricated removable and reusable insulation covers may be used. For piping insulation inside the building that service chilled water supply and return, condenser water supply and return, refrigerant suction, and A/C condensate drains, coat pipe insulation ends with vapor barrier coating not more than six inches from each flange, union, valve, anchor or fitting. Place insulation of the same thickness and conductivity as the adjoining pipe insulation (either premolded or segmented) around the item, butting the adjoining pipe insulation. If nesting size insulation is used, overlap the insulation 2 inches or one pipe diameter. Use loose fill mineral wool or insulating cement to fill the voids. Elbows insulated using segments shall not have less than 3 segments per elbow.

Insulation may be secured by wire or tape until finish coating is applied. Apply two coats of vapor barrier coating with glass tape embedded between coats. Overlap tape seams one inch. Extend the coating out onto the adjoining pipe insulation 2 inches. Where unions are shown not to be insulated, the insulation shall be tapered to the union at a 45 degree angle. Seal the insulation and jacket with two coats of vapor barrier coating with glass tape embedded between coats. Insulate anchors attached directly to the pipe for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface. Insulate flexible connections at pumps and other equipment with unicellular plastic insulation, unless otherwise indicated. At the option of the Contractor, premolded, one piece polyvinyl chloride (PVC) fitting covers may be used in lieu of the embedded glass tape. Factory premolded insulation or field fabricated insulation segments shall be used under the fitting covers. Blanket inserts may be used. Secure the covers with adhesive and vapor barrier tape with a vapor resistance of maximum 0.05 perm per ASTM E96, or with tacks made for securing PVC covers. Then coat all tape seams and tacks with Type II vapor barrier coating. Do not use premolded PVC fitting covers where exposed to weather. Limit the use of PVC covers to not less than 35 degrees F medium temperatures and below 150 degrees F ambient temperatures.

- G. Flanges, Unions, Valves, Fittings, and Accessories: Insulate and finish as specified for the applicable service. Apply two coats of an emulsion type weatherproof mastic for hot service and vapor barrier mastic for cold service recommended by the insulation manufacturer. Embed glass tape in the first coat. Overlap tape not less than 1 inch and the adjoining metal jacket not less than 2 inches. Factory preformed metal jackets may be used in lieu of the above for hot service.

### 3.03 DUCTS (HVAC) INSULATION

- A. Rigid Insulation: Secure rigid insulation by impaling over pins or anchors located not more than 3 inches from joint edges of boards, spaced not more than 12 inches on centers and secure with washers and clips. Spot weld anchor pins or attach with a waterproof adhesive especially designed for use on metal surfaces. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors. Each pin or anchor shall be capable of supporting a 20 pound load. Cut off protruding ends of pins, after clips are sealed with coating compound for inside work or manufacturer's recommended weatherproof coating for outside work, and reinforced with open weave glass membrane.
- B. Flexible Blanket Insulation: Apply insulation with all joints tightly butted. Secure insulation to ductwork with adhesive in 6 inch wide strips on 12 inch centers. Staple laps of jacket with outward clinching staples and seal with foil scrim kraft (FSK) tape. For ductwork over 24 inches on horizontal duct runs, provide pins, washers and clips. Use pins on sides of vertical ductwork being insulated. Space pins and clips on 18 inch centers and not more than 18 inches



from duct corners. Carry insulation over standing seams and trapeze type hangers. Install speed washers with pins and pin trimmed to washer. Sagging of flexible duct insulation will not be permitted. Cut off protruding ends of pins after clips are secured and sealed with coating compound for inside work. For warm air ducts, overlap insulation not less than 2 inches at joints and secure the laps with outward clinch staples on 4 inch centers. In cold air ducts, vapor seal all joints and staple as specified.

- C. Insulation Finishes and Joint Sealing: Fill all breaks, punctures, and voids with vapor barrier coating compound for inside work or manufacturers recommended weatherproof coating for outside service. Vapor seal all joints by embedding a single layer of 3 inch wide open weave glass membrane, 20 by 20 mesh maximum size between two 1/16 inch wet film thickness coats of vapor barrier coating compound. Draw glass fabric smooth and tight with a 1-1/2 inch overlap. At jacket penetrations such as hangers, thermometers, and damper operating rods, fill voids in the insulation with vapor barrier coating. Brush a coat of vapor barrier coating where required on HVAC ducts. Provide vapor barrier jacket continuous across seams, reinforcing, and projections. Where height of projections is greater than insulation thickness, carry insulation and jacket over the projection. For joints for heating only systems, provide insulation with two coats of fire resistant adhesive with glass fabric 20 by 20 maximum size mesh embedded between coats.
- D. Access Plates and Doors: On acoustically lined ducts, plenums, and casings, provide insulation on access plates and doors. On externally insulated ducts, plenums, and casings, provide insulation filled hollow steel panels and doors for access openings. Bevel insulation around access plates and doors.

### 3.04 FIELD INSPECTION

- A. Visually inspect to ensure that materials used conform to specifications. Inspect installations progressively for compliance with requirements.

END OF SECTION

## SECTION 23 31 13

### DUCTWORK AND DUCTWORK ACCESSORIES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Ductwork and Ductwork Accessories, as shown on the Plans, as specified and/or directed.
- B. Related work specified elsewhere:
  - 1. Division 1 – General Requirements
  - 2. Section 23 05 00 – General Mechanical Requirements
  - 3. Section 23 05 53 – Identification for HVAC Piping and Equipment
  - 4. Section 23 05 93 – Testing and Balancing Air and Water Systems
  - 5. Section 23 07 00 – HVAC Insulation
  - 6. Section 23 37 13 – Diffusers, Registers and Grilles

##### 1.02 REFERENCE STANDARDS

- A. The following is a list of standards that may be referenced in this Section:
  - 1. Air Diffusion Control (ADC) Publication:
    - a. 1062-R4 – Certification, Rating and Test Manual
    - b. AD – Measurement of Room to Room Sound Transmissions Through Plenum Air Systems
  - 2. Air Movement and Control Association, Inc. (AMCA) Publication:
    - a. 500 – Test Methods for Louvers, Dampers and Shutters
  - 3. American Society for Testing and Materials (ASTM) Publication:
    - a. A123 – Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
    - b. A167 – Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet, and Strip
    - c. A653 – Steel Sheet, Zinc-Iron Alloy coated (Galvanized) by the Hot Dip Process
    - d. B117 – Salt Spray (Fog) Testing
    - e. B127 – Nickel Copper Alloy (UNS N04400) Plate, Sheet, and Strip
    - f. B209 – Aluminum and Aluminum-Alloy Sheet and Plate
    - g. C423 – Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
    - h. C553 – Mineral Fiber Blanket and Felt Insulation (Industrial Type)
    - i. D822 – Operating Light and Water Exposure Apparatus (Carbon Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products

- j. D1654 – Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
- k. E84 – Test Method for Surface Burning Characteristics of Building Materials
- l. E90 – Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
- m. E96 – Water Vapor Transmission of Materials
- 4. National Fire Protection Association (NFPA) Publication:
  - a. 90A – Installation of Air Conditioning and Ventilating Systems
- 5. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Publication:
  - a. HVACTAB – HVAC Systems Testing, Adjusting and Balancing (HVACTAB)
  - b. HVACDCS – HVAC Duct Construction Standards Metal and Flexible (HVACDCS)
  - c. HVACALTM – HVAC Air Duct Leakage Test Manual (HVACALTM)
- 6. Underwriters Laboratories, Inc. (UL) Publications:
  - a. 181 – Factory Made Air Duct Connectors
  - b. 555 – Fire Dampers and Ceiling Dampers
  - c. 555S – Leakage Rated Dampers for Use in Smoke Control Systems
  - d. 586 – High Efficiency, Particulate, Air Filter Units
  - e. 723 – Test for Surface Burning Characteristics of Building Materials
- 7. Uniform Fire Prevention and Building Code of New York State Publication:
  - a. 2020 Mechanical Code
  - b. 2020 Energy Conservation Construction Code

### 1.03 SUBMITTALS

- A. Manufacturer's Catalog Data:
  - 1. Dampers
  - 2. Sound attenuators and sound attenuator ducts
  - 3. Acoustical duct lining and connectors
  - 4. Flexible ducts and connectors
  - 5. Duct liner adhesives
  - 6. Louvers
  - 7. Sheet Metals
  - 8. Test Holes
- B. Drawings:
  - 1. Ductwork Layout Plan
  - 2. Location of test holes

- C. Test Reports:
  - 1. Automatic dampers
    - a. Submit certification of damper leakage testing and conformance with AMCA 500, the International Energy Conservation Code and Supplement, and specified maximum leakage or pressure drop requirements.
  - 2. Sound Pressure level rating
  - 3. Corrosion protection
- D. Factory Test Reports:
  - 1. Sound attenuators and attenuator ducts acoustical tests
    - a. Submit certified test data from an independent acoustical testing laboratory, listing sound noise reduction characteristics, static pressure drop, air flow velocity capacity, and insertion loss data.
- E. Certificate of Compliance:
  - 1. Fire dampers and automatic dampers
- F. Field Test Reports:
  - 1. Air duct leakage tests
  - 2. Testing and balancing of air systems

#### 1.04 QUALITY ASSURANCE

- A. SMACNA Duct Construction Manuals: The SMACNA recommendations shall be considered as mandatory requirements. Substitute the word "shall" for the word "should" in these manuals. No negative pressure construction for 4 inch, 6 inch, or 10 inch water gauge is provided herein.

#### 1.05 TESTING FOR CORROSION PROTECTION

- A. Comply with ASTM A123 or protect the equipment with a corrosion inhibiting coating or paint system that has proved capable of satisfactorily withstanding corrosion in accordance with ASTM B117. Test 125 hours for equipment installed indoors and 500 hours for equipment installed outdoors or subjected to marine atmosphere. Each specimen shall have a standard scratch as defined in ASTM D1654.
  - 1. Corrosion Criteria: Upon completion of exposure, coating or paint shall show no indication of deterioration or loss of adhesion, nor shall there be indication of rust or corrosion extending further than 1/8 inch on either side of original scratch.
  - 2. Thickness of Coating: Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry film thickness.

#### 1.06 PRESSURE VELOCITY CLASSIFICATION

- A. SMACNA HVACDCS, Section 1, and as indicated.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Galvanized Steel Sheets: ASTM A653; coating designation G90.
- B. Galvanized Steel Hot Dipped After Fabrication: ASTM A123.
- C. Aluminum Alloy Sheets: ASTM B209
- D. Corrosion Resisting (Stainless) Steel Sheets: ASTM A167.
- E. Duct Liner Adhesives: SMACNA HVACDCS, fire resistant adhesive.

### 2.02 DUCTS OF PRESSURE CLASSES 2-INCH OR LESS WATER GAUGE

- A. Construction, metal gauge, hangars and supports, and reinforcements shall conform with SMACNA HVACDCS. Ductwork shall be airtight and shall not vibrate or pulsate when system is in operation. Air leakage shall be less than 5 percent of the system capacity. Construct ductwork of galvanized steel
  - 1. Curved Elbows: Make a center line radius not less than 1-1/2 times the width or diameter of the duct.
  - 2. Joints: Make airtight. No dust marks from air leaks shall show at duct joints or connections to grilles, registers, and diffusers.
  - 3. Laps: Make laps at joints in the direction of airflow. Space button punch or bolt connection in standing seams at fixed centers not greater than 6 inches. Longitudinal locks or seams, known as "Button Punch Snap Lock" may be used in lieu of Pittsburgh Lock.
  - 4. Fittings: Elbows, vaned elbows, take offs, branch connections, transitions, splitters, volume dampers, fire dampers, flexible connections, and access door shall conform with SMACNA HVACDCS, Section 2. Factory fabricate test holes to be airtight and noncorrosive with screw cap and gasket.
  - 5. Acoustical Attenuator Systems: Acoustical Duct Lining, Sound Attenuators (Traps), and Sound Attenuator Ducts:
    - a. Acoustical Duct Lining: Flexible or rigid mineral fiber lining conforming to FS HH I 545. Lining shall not be less than one inch thick. Increase duct sizes indicated to compensate for the thickness of lining.
    - b. Net Noise Reduction Values: Conform with the following:

Minimum Net Noise Reduction Values,  
Sound Pressure Level dB  
(Reference Sound Power at 10 12 Watts)

Octave Pass Band	2	3	4	5	6	7
Center Frequency (Hz)	125	250	500	1000	2000	4000
Noise Reduction (dB)	11	16	19	30	40	32

- c. Preformed Duct Liner: Preformed round duct liner designed for insertion in round ducts may be used in the sizes commercially available. Provide duct liner sections with slip lap joints not less than 2 inches wide. Make joints in accordance with the printed instructions of the manufacturer. Furnish fire resistant adhesive to field coated joints when recommended by the manufacturer to prevent delamination or erosion at the joints. Tubular sections of duct liner shall fit the metal duct snugly and without gaps between duct liner sections.
- d. Factory Fabricated Sound Attenuator Ducts: Sound attenuator ducts may be provided in lieu of sound attenuators. Comply with requirements specified herein for sound attenuators. Construct each double walled duct and fitting of an outer zinc coated metal pressure shell with one- inch thick acoustical blanket insulation and an internal perforated zinc coated metal liner. Install sufficient length of run to obtain the noise reduction value specified. The manufacturer shall certify that the sound reduction value specified will be obtained within the length of duct run provided. The internal perforated zinc coated metal liner shall be not less than 24 gauge, unless ribbed, then not less than 28 gauge for the duct liner and not less than 26 gauge for the fitting liner with perforations not larger than 3/32 inch diameter.
- e. Sound Attenuators (Traps): Factory fabricated. Construct of galvanized steel sheets. The outer casing shall be not less than 22 gauge. Acoustical fills shall be mineral fiber conforming to FS HH I 545ASTM E84 and UL 723. Air flow capacities shall be as indicated. Pressure drops through the attenuators shall not exceed the values indicated, or shall be not in excess of 15 percent of the total external static pressure of the air handling system, whichever is less. Acoustically test sound attenuators with metal duct inlet and outlet sections while under the rated air flow conditions. Noise reduction data shall include the effects of flanking paths and vibration transmission. Construct attenuators to be airtight when operating at the internal static pressure not less than 2 inches water gauge. Conform with noise reduction requirements specified in paragraph entitled "Net Noise Reduction Values".

## 2.03 FLEXIBLE DUCTS

- A. UL 181, Class I, UL listed, SMACNA HVACDCS, and additional requirements herein specified. Use to connect between rigid ducts and outlets or terminals. There shall be no erosion, delamination, loose fibers, or odors from the ducts into the air stream. At 250 degrees F, minimum rating pressures shall be 2 inches water positive and 1-1/2 inches negative up to 2500 cfm flexible ducts. Flexible ducts shall be maximum 3 feet in length. Minimum bend radius shall be twice of the duct diameter.
1. Materials: Interlocking spiral or helically corrugated type constructed of noncollapsible fire retardant, chloroprene or chlorosulphonated polyethylene impregnated, minimum 30 ounces per square yard woven mineral fabric.
  2. Insulation and Vapor Barrier: ASTM C553; minimum one inch nominal thickness and one lb./cu. ft. density. The insulation shall be sheathed with a vapor barrier having a maximum water vapor permeance of 0.02 perm per ASTM E96, Procedure C. Coat ends of insulation with cement to prevent erosion and delamination.
  3. Joints: Make airtight slip joints, seal with pressure sensitive vapor seal adhesive tape or duct sealer, and secure with sheet metal screws. To prevent insulation compression, place 2 inch wide by one inch thick closed cell foam plastic spacers over the joints under vapor barriers. To provide a vapor-tight joint, use a zinc coated steel clamp over such spacers.

## 2.04 FLEXIBLE CONNECTORS

- A. UL 181, Class I, UL listed, SMACNA HVACDCS, and additional requirements herein specified. Connectors to be ASTM A653, 24-gauge galvanized steel, with commercial neoprene fire retardant coating meeting NFPA 701 with 500 lb tensile strength at a temperature range of -40°F to 200°F. Use to connect between rigid ducts and equipment inlets and outlets as indicated. There shall be no erosion, delamination, loose fibers, or odors from the ducts into the air stream.

## 2.05 DUCT SLEEVES AND PREPARED OPENINGS

- A. Duct Sleeves and Closure Collars: Fabricate from minimum 20 gauge galvanized steel. Where sleeves are installed in bearing walls, provide structural steel sleeves as indicated.
- B. Prepared Openings: Provide one inch clearance between the duct and the sleeve.

## 2.06 DEFLECTORS

- A. Factory fabricated and factory or field assembled units consisting of curved turning vanes for uniform air distribution and change of direction with minimum turbulence and pressure loss. Provide curved vanes for square elbows.

- B. For round ducts taking off from rectangular ducts, provide factory fabricated, galvanized sheet metal, spin in fittings. These fittings shall have scoop extractors, butterfly dampers, and locking quadrant operators.

## 2.07 ACCESS DOORS

- A. Weld door frame in place. Door shall be rigid and airtight with neoprene gaskets and two or more galvanized steel hinges and tension fasteners. Provide doors as large as practical. Mount doors, if possible, so that air pressure holds them closed.

## 2.08 DAMPERS AND LOUVERS

- A. Construct dampers and louvers with two gauges heavier than ducts in which installed. Except as modified herein, the construction shall be of aluminum or galvanized steel with interlocking edges and maximum 10 inch blade width. Conform with SMACNA HVACDCS. Dampers shall be opposed blade type where indicated.
- B. Backdraft Dampers (Gravity Dampers or Shutters): Factory fabricated, with statically and dynamically balanced blades that open automatically when the fan starts and close by gravity when the fan stops. Provide the edges of blades with felt or rubber strips to prevent rattling.
- C. Manual Volume Dampers: Balancing, factory fabricated type. Equip dampers with accessible mechanism such as quadrant operators or 3/16 inch rods brought through the side of ducts with locking setscrew and bushing. Where quadrant operators are used, they shall be chrome plated or enamel painted with all exposed edges rounded.
- D. Fire Dampers: Provide in accordance with UL 555. Units shall be accordion type with 180° F fusible link with rating to match chase enclosure. Pressure drop in open position shall not exceed 0.1 inch w.g. Damper shall be designed for and labeled for use in dynamic systems. Static only damper labels are not permissible. The damper shall be rated for dynamic closure at air velocities and static pressures that will be encountered in the application. The damper shall be tested and rated to close with airflow in either direction.
- E. Bird Screens: ASTM E437, general industrial-use wire cloth, Grade C, (medium light) or heavier, nominal 2 mesh 0.063-inch wire diameter, aluminum bird screens. Provide removable insect screens of grooved type, with vinyl or neoprene spline insert for securing screen cloth.

## 2.09 DUCTWORK AND EQUIPMENT INSULATION

- A. Section 23 07 00, "HVAC Insulation".



## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Installation shall conform to NFPA 90A, SMACNA HVACDCS. Provide mounting and supporting of ductwork and accessories including, but not limited to, structural supports, hangers, vibration isolators, stands, clamps and brackets, access doors, and dampers. Use electrical isolation between dissimilar metals. Electrical isolation may be fluorinated elastomers or sponge rubber gaskets. Install ductwork accessories as indicated in accordance with the manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service.
1. Ductwork: When air distribution systems are operated, there shall be no chatter, vibration, or dust marks. After ducts are thermally or acoustically insulated, ensure air flow area equal to duct cross section dimensions indicated.
    - a. Field Changes to Ductwork: Those required to suit the sizes of factory fabricated equipment actually furnished, shall be designed to minimize expansion and contraction. Use gradual transitions in field changes as well as modifications to connecting ducts.
    - b. Dampers: When installed on ducts to be thermally insulated, equip each damper operator with stand-off mounting brackets, bases, or adapters to provide clearance between the duct and operator not less than the thickness of insulation. Stand-off mounting items shall be integral with the operator or standard accessory of damper manufacturer.
    - c. Deflectors: Provide in square elbows, duct mounted supply outlets, take off or extension collars to supply outlets, and tap in branch off connections. Adjust supply outlets to provide air volume and distribution as indicated or specified.
    - d. Fire Dampers: Install for ducts penetrating fire walls and where duct systems serve two or more floors in accordance with UL 555.
    - e. Access Doors: Provide for automatic dampers, volume dampers, fire dampers, coils, thermostats, temperature controllers, valves, filters, humidifiers and other concealed apparatus requiring service and inspection in the duct systems.
    - f. Duct Sleeves and Prepared Openings: Install for duct mains, duct branches, and ducts passing through roofs and ceilings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings.
      - 1) Duct Sleeves: Allow one inch clearance between duct and sleeve or one inch clearance between insulation and sleeve for insulated ducts, except at grilles, registers, and diffusers.

- 2) Prepared Openings: Allow one inch clearance between duct and opening or one inch clearance between insulation and opening for insulated ducts, except at grilles, registers, and diffusers.
  - 3) Closure Collars: Provide not less than 4 inches wide on each side of walls or floors where sleeves or prepared openings are installed. Fit collars snugly around ducts and insulation. Grind smooth edges of collar to preclude tearing or puncturing insulation covering or vapor barrier. Use nails with maximum 6 inch centers on collars.
2. Duct Hangers and Supports: SMACNA HVACDCS, Section 4. Unless otherwise indicated, provide not less than two one inch by 1/16 inch galvanized strap iron hangers spaced one on each side of duct. Anchor risers in the center of the vertical run to allow ends of riser free vertical movements. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing. Where C clamps are used, use retainer clips.
    - a. Flexible Ducts: Support ducts by hangers every 3 feet. Use stretch flexible air ducts to smooth out corrugations, and long radius elbows, where possible, using a minimum length to make connections.
    - b. Flexible Connectors: Provide flexible connectors between fans and ducts or casings and where ducts are of dissimilar metals. For round ducts, securely fasten flexible connectors by zinc coated steel clinch type draw bands. For rectangular ducts, lock flexible connectors to metal collars.
  3. Flashings: Provide waterproof flashings where ducts pass through exterior walls and roofs.
  4. Inspection Plates and Test Holes: Provide, where required, in ductwork or casings for all balance measurements. Test holes shall be factory fabricated, airtight, and noncorrosive with screw cap and gasket. Extend cap through insulation.
  5. Acoustical Duct Lining: SMACNA HVACDCS, Section 2. Apply the lining in cut to size pieces attached to interior of ducts with fire resistant adhesive. Top and bottom pieces shall lap the side pieces. Secure pieces together with welded pins or clips. Do not distort the ducts, burn through or mar the finish surface of ducts. Pins and washers shall be flush with the surface of duct liners. Seal breaks and punctures of duct liner coating with fire resistant adhesive. Coat exposed edges of the liner at duct ends and other joints where lining will be subject to erosion with a heavy brush coat of fire resistant adhesive, to prevent delamination of glass fibers. Duct liners may also be applied to flat sheet metal with fire resistant adhesive,

at top and bottom surface of ducts; then secure duct liners by welded pins or adhered clips.

6. Cleaning of Ducts:

- a. Remove all debris and dirt from ducts utilizing high-power vacuum machines and wipe clean. Use existing openings to air devices for access into ductwork. Remove existing flexible ducts to access main ducts and branch ductwork. Reinstall flexible connections once system has been cleaned.
- b. Mark position of existing volume dampers and air-directional mechanical devices inside HVAC system prior to cleaning. When cleaning is complete, restore dampers and devices to their marked positions.
- c. Wipe clean existing air devices to remain prior to reconnecting to existing ductwork.
- d. Before installing air outlets, use air handler to blow dry air through entire system at maximum attainable velocity. Provide temporary air filters for this operation.

### 3.02 TESTING AND COMMISSIONING

- A. The Contractor is responsible for the administration and direction of tests. Furnish instruments, equipment, connecting devices, and personnel for the tests. Notify Engineer 5 days before inspection or testing is scheduled. Correct all defects in the work. Repeat tests until the work is in compliance.
  1. Performance Testing and Balancing: Section 23 05 93, "Testing and Balancing Air and Water Systems".

END OF SECTION

## SECTION 23 37 13

### DIFFUSERS, REGISTERS AND GRILLES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Diffusers, Registers and Grilles, as shown on the Plans, as specified and/or directed.
- B. Related work specified elsewhere:
  - 1. Section 23 05 00 – Mechanical General Requirements
  - 2. Section 23 05 93 – Testing and Balancing of Air and Water Systems
  - 3. Section 23 31 13 – Ductwork and Ductwork Accessories

##### 1.02 REFERENCE STANDARDS

- A. The following is a list of standards that may be referenced in this Section:
  - 1. Air Diffusion Control (ADC) Publication:
    - a. 1062-R4 – Certification, Rating and Test Manual
    - b. AD – Measurement of Room to Room Sound Transmissions Through Plenum Air Systems
  - 2. Air Conditioning, Heating and Refrigeration Institute (AHRI) Publication:
    - a. 881 – Performance Rating of Air Terminals
  - 3. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) Publication:
    - a. 70 – Performance of Air Outlets and Air Inlets Testing Method
  - 4. American Society for Testing and Materials (ASTM) Publication:
    - a. A123 – Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
    - b. A527 – Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process Lock Forming Quality
    - c. B117 – Corrosive Environments Salt Spray Test
    - d. C423 – Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
    - e. C553 – Mineral Fiber Blanket and Felt Insulation for Commercial and Industrial Applications
    - f. D870 – Water Immersion Test
    - g. D2794 – Reverse Impact Cracking Test
  - 5. National Fire Protection Association (NFPA) Publication:
    - a. 90A – Installation of Air Conditioning and Ventilating Systems

6. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Publications:
  - a. HVACTAB – HVAC Systems Testing, Adjusting and Balancing (HVACTAB)
  - b. HVACDCS – HVAC Duct Construction Standards Metal and Flexible (HVACDCS)
7. Underwriters Laboratories, Inc. (UL) Publication:
  - a. 181 – Factory Made Air Duct Connectors
8. Uniform Fire Prevention and Building Code of New York State Publication:
  - a. 2020 Mechanical Code

### 1.03 SUBMITTALS

- A. Manufacturer's Data:
  1. Diffusers, registers and grilles
    - a. Submit a schedule of all inlets and outlets indicating location, catalog model number, manufacturer, dimensional information, sound pressure level rating, nominal rated volumetric flow rate (cfm), neck or face velocity at specified cfm, pressure drop at specified cfm, throw and drop for outlets, range for diffusers, and maximum and minimum cfm modulation.
- B. Test Reports:
  1. Sound pressure level rating
    - a. Submit for inlets and outlets including diffusers, registers and grilles.

### 1.04 QUALITY ASSURANCE

- A. SMACNA Duct Construction Manuals: The SMACNA recommendations shall be considered as mandatory requirements. Substitute the word "shall" for the word "should" in these manuals.

## PART 2 - PRODUCTS

### 2.01 DIFFUSERS, REGISTERS, AND GRILLES

- A. Material and Finishes: Construct diffusers, registers, and grilles of or aluminum. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Air outlets shall be factory treated and painted with a baked on anodic acrylic paint and pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must also meet testing requirements in accordance with ASTM B870 and D2794. Colors shall be selected or approved by the Engineer.

- B. Sound Pressure Level: Manufacturer certified sound pressure level rating of inlets and outlets in accordance with ADC 1062 R4. Conform with the following permissible room sound pressure levels:

NC Range, dB	Typical Application
20 – 25	Private Offices and Conference Rooms
30 – 40	Corridors
25 – 30	Classrooms
20 – 25	Courtrooms

- C. Throw: Defined as distance from the diffuser, register, or grille to the point which the air velocity falls below 50 feet per minute. Throw shall not exceed 1.5 times the outlet mounting height.
- D. Drop: Maximum drop of air stream shall not be so great that it is within 5 feet of the floor at the end of the throw.
- E. Ceiling Diffusers: Equip with baffles or other devices required to provide proper air distribution pattern. Provide factory fabricated, single key, volume dampers. Except for linear air diffusers, internal parts shall be removable through the diffuser neck for access to the duct and without the use of special tools.
1. Circular, Square, and Rectangular Diffusers: Construct each ceiling diffuser of three precision die-stamped cones designed to deliver air in a generally horizontal direction without excess smudging of the ceiling. The back cone shall include an integrally drawn inlet. The two inner cones shall be constructed as a single, removable inner core assembly with removal center plug to allow adjustment of inlet damper without removal of inner core assembly. Diffusers shall be supplied with a round damper operable from the face of the diffusers. Diffusers shall be in lay-in type or plaster mounted frame of 24"x24" or 12"x12" as indicated. Manufacture shall be as by Titus Model TMS, or approved equal.
- F. Return/Exhaust Registers: Provide exhaust and return registers as specified for supply registers, except that they shall have a single set of nondirectional face bars or vanes having the same appearance as the supply registers. Set face bars or vanes at 45 degrees. Registers shall be in lay-in type or plaster mounted frame of 24"x24" or 12"x12" as indicated. Manufacture shall be as by Titus Model 350 RL, or approved equal

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Installation shall conform to NFPA 90A, SMACNA HVACDCS. Install diffusers, registers, grilles and accessories as indicated in accordance with the manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service.

### 3.02 FIELD TESTS AND INSPECTIONS

- A. The Contractor is responsible for the administration and direction of tests. Furnish instruments, equipment, connecting devices, and personnel for the tests. Correct all defects in the work. Repeat tests until the work is in compliance.
  - 1. Performance Testing and Balancing: Testing and Balancing shall be performed in accordance with Section 23 05 93, "Testing and Balancing Air and Water Systems".

END OF SECTION

## SECTION 23 74 16

### PACKAGED ROOFTOP AIR CONDITIONING UNIT

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Packaged Rooftop Air Conditioning Unit, as shown on the Plans, as specified, and/or directed.
- B. Related work specified elsewhere:
  - 1. 23 05 00 – General Mechanical Requirements
  - 2. 23 05 53 – Identification for HVAC Piping and Equipment
  - 3. 23 05 93 – Testing and Balancing of Air and Water Systems
  - 4. 23 11 23 – Fuel Gas Piping
  - 5. 23 31 13 – Ductwork and Ductwork Accessories
  - 6. Division 26 – Electrical

##### 1.02 REFERENCE STANDARDS

- A. The following is a list of standards that may be referenced in this section:
  - 1. Air Conditioning, Heating and Refrigeration Institute (AHRI) Publication:
    - a. 210/240 – Unitary Air Conditioning and Air-Source Heat Pump Equipment
    - b. 260 – Application, Installation and Servicing of Unitary Systems
    - c. 340/360 – Commercial and Industrial Unitary Air Conditioning Equipment
    - d. DCAACP – Directory of Certified Applied Air Conditioning Products
    - e. DCUAC – Directory of Certified Unitary Air Conditioners
  - 2. Air Movement and Control Association International, Inc. (AMCA)
    - a. 210 – Laboratory Method of Testing Fans for Rating
    - b. 300 – Reverberant Room Method for Sound Testing of Fans
    - c. 500 – Laboratory Methods of Testing Louvers, Dampers and Shutters
    - d. 511 – Product Rating Manual for Air Control Devices
  - 3. American National Standards Institute, Inc. (ANSI) Publication:
    - a. B16.22 – Wrought Copper and Bronze Solder-Joint Pressure Fittings
    - b. B31.5 – Refrigerant Piping
    - c. Z21.47 – Gas-fired Central Furnaces



4. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) Publication:
  - a. 15 – Safety Code for Mechanical Refrigeration
  - b. 52 – General Ventilation Air-Cleaning Devices for Removal Efficiency by particle Size
  - c. 62.1 – Ventilation for Acceptable Indoor Air Quality
  - d. 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings
  - e. 135 – BACNET™ — A Data Communication Protocol for Building Automation and Control Networks
5. American Society for Testing and Materials (ASTM) Publication:
  - a. A123 - Zinc (Hot Dip Galvanized) Coatings on Iron Steel Products
  - b. B117 - Salt Spray (Fog) Testing
  - c. D1654 - Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
  - d. E477 - Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers
6. National Electrical Manufacturers Association (NEMA) Publication:
  - a. ICS2 – Industrial Control Devices, Controllers and Assemblies
  - b. ICS6 – Enclosures for Industrial Controls and Systems
  - c. MG1 – Motors and Generators
7. National Fire Protection Association (NFPA) Publication:
  - a. 70 - National Electrical Code
  - b. 90A - Installation of Air Conditioning and Ventilating Systems
8. Uniform Fire Prevention and Building Code of New York State Publication:
  - a. 2020 Mechanical Code of New York State
  - b. 2020 Energy Conservation Construction Code of New York State

### 1.03 SUBMITTALS

- A. Manufacturer's Data:
  1. Rooftop Unit
  2. Roof Curb
- B. Test Reports:
  1. Rooftop Unit Field Test Reports – Include certification by the equipment manufacturer's representative
- C. Certificate of Conformance:
  1. Rooftop Unit
- D. Operation and Maintenance Manuals:
  1. Rooftop Unit

## 1.04 TESTING FOR CORROSION PROTECTION

- A. Comply with ASTM A123, or protect the equipment with a corrosion inhibiting coating or paint system that has proved capable of satisfactorily withstanding corrosion in accordance with ASTM B117. Test 125 hours for equipment installed indoors and 500 hours for equipment installed outdoors or subjected to a marine atmosphere. Each specimen shall have a standard scratch as defined in ASTM D1654.
1. Corrosion Criteria: Upon completion of exposure, coating or paint shall show no indication of deterioration, loss of adhesion, or any indication of rust or corrosion extending further than 1/8 inch on either side of original scratch.
  2. Thickness of Coating: Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry film thickness.
    - a. Mild Steel and Factory Primed Surfaces:
      - 1) Synthetic Resin Primer: 36 percent plus or minus 6 percent solids content by volume; 1 coat, 3 mils minimum dry film thickness.
      - 2) Vinyl Copolymer: 23 percent plus or minus 4 percent solids content by volume; 2 coats, 1-1/2 mils minimum dry film thickness per coat.
    - b. Nonferrous Heat Exchanger Fin Coil Surfaces: Vinyl copolymer, 4 coats, 1-1/2 mils minimum dry film thickness per coat.
    - c. Galvanized Surfaces:
      - 1) Polyamide Epoxy Primer: 48 percent plus or minus 2 percent solids content by volume; 1 coat, 2 mils minimum dry film thickness.
      - 2) Vinyl Copolymer: 23 percent plus or minus 4 percent solids content by volume; 2 coats, 1-1/2 mils minimum dry film thickness per coat.
    - d. Aluminum Surfaces Other than Fin Coil Surfaces:
      - 1) Polyamide Epoxy Primer: 48 percent plus or minus 2 percent solid contact by volume; 1 coat, 2 mils minimum dry film thickness.
      - 2) Vinyl Copolymer: 23 percent plus or minus 4 percent solids content by volume; 2 coats, 1-1/2 mils minimum dry film thickness per coat.

## 1.05 MOTORS

- A. NEMA MG1. Motor starters shall conform to NEMA ICS1 and NEMA ICS2. Determine specific motor characteristics to insure provision of correctly sized starters and overload heaters. Motors shall be designed to operate at full capacity with a voltage variation of plus or minus 10 percent of the motor voltage rating. Motor size shall be sufficient for the duty to be performed and shall not exceed its

full load nameplate current rating when driven equipment is operated at specified capacity under the most severe conditions likely to be encountered. When motor size provided differs from the size indicated or specified, the Contractor shall make the necessary adjustments to the wiring, disconnect devices, and branch circuit protection to accommodate the equipment actually provided.

## 1.06 SAFETY

- A. Comply with OSHA 29 CFR 1910.
- B. Design, manufacture, and installation of mechanical refrigeration equipment shall conform to ASHRAE 15.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. ROOFTOP AIR CONDITIONING UNIT (RT): The unit shall be a factory assembled and packaged combination heating and cooling unit. Unit shall be available for direct expansion cooling only, or direct expansion cooling with natural gas heating. Provide unit with suitable lifting attachments, downflow duct, filters, outside air system, barometric relief system, optional non-fused disconnect switches, hinged access doors, roof curb, base rail, and all operating and safety controls furnished factory installed. Submit data to demonstrate that the unit will produce the performance factors specified and/or scheduled. The unit capacity, electrical characteristics, optional accessories and operating conditions shall be as scheduled on Contract Drawings, and have a minimum EER of 13.6 when tested in accordance with AHRI 340/360. Contained within the unit enclosure shall be all factory wiring, piping, controls, refrigerant charge (R-410A), and special features required prior to field startup. Manufacture shall be as by Trane Model YHJ, or approved equal.
  - 1. Casings: Construct casings of double-wall zinc coated galvanized steel, with mid-space internal thermal break between panels. Provide removable panels and access doors for inspection and access to internal parts. Roof and panel insulation in contact with the return and conditioned air stream shall have ½-inch thick foil faced fiberglass insulation. External surface of unit casing shall be factory coated with a minimum 1.5 mil enamel finish and tested in accordance with ASTM B117.
  - 2. Supply Blower (Fan) Sections: Supply fans shall have single centrifugal double-inlet, forward-curved fans mounted on a common shaft with fixed sheave drive. Fans shall be direct drive, statically and dynamically balanced at factory. Fans shall be mounted on grease lubricated ball bearings. Fan motor shall be open drip proof, variable speed premium efficiency with thermal overload protection and phase failure protection. Fan motor shall meet MG1 requirements, and comply with NEMA premium efficiency levels.

3. Condenser Fan: Fans shall be direct-driven dynamic profile for low tip speed, and low noise blade design. Fan motors shall be permanently lubricated with built-in current and thermal overload protection.
4. Phase Monitor: Three-phase line monitor, with LED indicators for ON and FAULT.
5. Condensing Section: Units shall incorporate R-410A refrigerant circuits containing fully hermetic scroll type compressors. The motor shall be suction gas-cooled hermetic design. Compressor shall have centrifugal oil pump with dirt separator, oil sight glass, and oil charging valve. Compressor shall be provided with thermostatic motor winding temperature control. Compressor section shall be provided with hail guards. Compressor shall have a crankcase heater.
6. Refrigerant Circuits: Each refrigerant circuit shall have independent thermal expansion valves, service pressure ports, and refrigerant line filter driers.
7. Evaporator and Condenser Coils: Direct expansion coil fabricated of seamless copper tubing mechanically expanded into high efficiency aluminum plate fins, leak tested to 480 to 650 psig. Condenser coils shall be microchannel type.
8. Heating Section: Gas Heating section shall be natural gas fired, induced draft, direct spark ignition system, factory mounted, and constructed of corrosion resistant steel heat exchanger and burners. The system shall have single heating, airflow safety switch, initial purge sequence, high temperature limit switch, and three ignition attempts before system lockout.
9. Filter Section: Throwaway type with 2-inch filters, and MERV 8 rating.
10. Powered Convenience Outlet: Provide GFCI, 120V/15 amp, 2-plug powered convenience outlet on unit.
11. Economizer: Unit shall be provided with an outdoor air economizer including outdoor, return and exhaust air parallel blade dampers. Economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling. Outdoor air hood shall be factory installed and constructed of galvanized steel, and shall include moisture eliminator filters, and bird screen on intake and exhaust openings. Damper actuators shall be modulating, spring return type. Economizer control shall utilize comparative enthalpy control to sense and compare both outdoor and return air enthalpy. Fully modulating 0-100% motor and dampers, powered exhaust, minimum position setting, preset linkage, and differential enthalpy control.
12. Roof Curb: Roof curb shall be pre-fabricated 14-gauge galvanized steel, designed to mate with downflow unit and provide support and water tight installation for field assembly. Curb shall provide field-fabricated rectangular supply/return ductwork to connect directly to curb and include wood nailer strips. Gasket shall be provided for field mounting between the unit base and roof curb.

- B. Controls: Provide a completely integrated microprocessor based Direct Digital Control (DDC) system to control all functions as follows:
1. Temperature Control.
  2. Scheduling.
  3. Monitoring.
  4. Unit safety protection, including compressor minimum run and minimum off times and diagnostics.
  5. All required temperature sensors, pressure sensors, controller and keypad/display operator interface.
  6. The DDC control system shall be standalone and shall maintain existing set points and schedules in a nonvolatile memory. DDC control system shall consist of a high speed, peer to peer network of DDC controllers, a control system supervisory controller and a web based operator interface.
  7. The control system will be accessed using a web browser over the control system network, the owner's local area network and over the internet. No special software other than a web browser shall be required to access graphics, trends, schedules, and alarms for the control system.
  8. The system shall use open BACnet protocol for communication between all the equipment communication interfaces and supervisory controller.
  9. Manufacture of DDC Control system shall be as by Trane Tracer Concierge.
  10. Sequence of Operation for all new rooftop units:
    - a. Building Automation System Interface:
      - 1) The Building Automation System (BAS) shall send the controller Occupied Bypass, Morning Warm-up/Pre-Cool, Occupied/Unoccupied and Heat/Cool modes. If a BAS is not present, or communication is lost with the BAS the controller shall operate using default modes and setpoints.
    - b. Occupied:
      - 1) During occupied periods, the supply fan shall run continuously and the mixed air dampers shall open to maintain minimum ventilation requirements. Upon a call for DX cooling, the unit controller shall enable the first fixed speed compressor. If the fixed speed compressor cannot satisfy the load conditions, the unit controller shall start the next fixed speed compressor in sequence to add to the total unit cooling load percentage. This process shall repeat until all of the fixed speed compressors have been started or until the active space temperature setpoint is satisfied. If economizing is enabled, the outdoor air or mixed air dampers shall modulate to maintain the discharge air temperature setpoint and the relief air damper shall track the mixed air dampers. The discharge air temperature setpoint shall be dynamically reset based on the deviation of actual space temperature from the active space temperature setpoint. If the discharge air temperature

sensor fails, the DX cooling and the gas heat shall control to maintain the active space temperature setpoint and an alarm shall annunciate at the BAS. If the discharge air temperature sensor and the space temperature sensor fail, the DX cooling shall be disabled, the gas heat shall be disabled, and an alarm shall annunciate at the BAS.

c. Unoccupied:

- 1) When the space temperature is below the unoccupied heating setpoint of 60.0 deg. F (adj.) the supply fan shall be commanded on, the outside air damper shall remain closed and the gas heat shall be enabled. When the space temperature rises above the unoccupied heating setpoint of 60.0 deg. F (adj.) plus the unoccupied differential of 4.0 deg. F (adj.) the supply fan shall stop and the gas heat shall be disabled. When the space temperature is above the unoccupied cooling setpoint of 85.0 deg. F (adj.) the supply fan shall be commanded on, the outside air damper shall open if economizing is enabled and remain closed if economizing is disabled and the DX cooling shall be enabled. When the space temperature falls below the unoccupied cooling setpoint of 85.0 deg. F minus the Unoccupied differential of 4.0 deg. F (adj.) the supply fan shall stop, the DX cooling shall be disabled and the outside air damper shall close.

d. Optimal Start:

- 1) The BAS shall monitor the scheduled occupied time, occupied space setpoints and space temperature to calculate when the optimal start occurs.

e. Morning Warm-Up Mode:

- 1) During optimal start, if the space temperature is below the occupied heating setpoint a morning warm-up mode shall be activated. When morning warm-up is initiated the unit shall enable the heating and fan(s). The outside air damper shall remain closed. When the space temperature reaches the occupied heating setpoint (adj.), the unit shall transition to the occupied mode.

f. Pre-Cool Mode:

- 1) During optimal start, if the space temperature is above the occupied cooling setpoint, pre-cool mode shall be activated. When pre-cool is initiated the unit shall enable the fan and cooling or economizer. The outside air damper shall remain closed, unless economizing. When the space temperature reaches occupied cooling setpoint (adj.), the unit shall transition to the occupied mode.

- g. Optimal Stop:
  - 1) The BAS shall monitor the scheduled unoccupied time, occupied setpoints and space temperature to calculate when the optimal stop occurs. When the optimal stop mode is active the unit controller shall maintain the space temperature to the space temperature offset setpoint. Outside air damper shall remain enabled to provide minimum ventilation.
- h. Occupied Bypass:
  - 1) The BAS shall monitor the status of the ON and CANCEL buttons of the space temperature sensor. When an occupied bypass request is received from a space sensor, the unit shall transition from its current occupancy mode to occupied bypass mode and the unit shall maintain the space temperature to the occupied setpoints (adj.).
- i. Heat/Cool Mode:
  - 1) When the space temperature rises above the occupied cooling setpoint the mode shall transition to cooling. When the space temperature falls below the occupied heating setpoint the mode shall transition to heating. When the space temperature is above the occupied cooling setpoint or below the occupied heating setpoint the mode shall remain in its last state. If the space temperature sensor fails the mode shall remain in its last state and an alarm shall annunciate at the BAS. If the local and communicated setpoints fail the controller shall disable the supply fan and an alarm shall annunciate at the BAS.
- j. Economizer:
  - 1) ENABLE (Comparative Dry Bulb): Outside air (OA) temperature shall be compared with space temperature. The economizer shall enable when OA temperature is less than space temperature - 2.0 deg. F. The economizer shall disable when OA temperature is greater than space temperature.
  - 2) OPERATION: The unit shall measure the dry bulb supply air temperature and dry bulb outdoor air temperature and economizer shall be enabled when the outdoor air temperature is below the dry bulb change over setpoint. When economizing is enabled and the unit is operating in the cooling mode, the economizer damper shall be modulated between its minimum position and 100% to maintain the discharge air temperature setpoint. The economizer damper shall modulate toward minimum position in the event the discharge air temperature falls below the discharge low limit temperature setpoint.

Compressors shall be delayed from operating until the economizer has opened to 100%.

- k. Supply Fan:
  - 1) The supply fan shall be enabled while in the occupied mode and cycled on during the unoccupied mode.
- l. Relief Air and Building Pressure Control:
  - 1) The barometric relief dampers shall open with increased building pressure. As the building pressure increases, the pressure in the unit return section also increases, opening the dampers and relieving air.
- m. Filter Timer:
  - 1) The fan-run time (hrs) shall be compared to the filter maintenance timer setpoint. Once the setpoint is reached a filter timer alarm diagnostic shall annunciate at the BAS. When the diagnostic is cleared, the filter-maintenance timer is reset to zero, and the timer begins accumulating fan-run time again.

## PART 3 - EXECUTION

### 3.01 INSTALLATION: AHRI 260, AND AS SPECIFIED HEREIN

- A. General: Install equipment and components in a manner to insure proper and sequential operation of the equipment and equipment controls. Installation of equipment shall be in accordance manufacturer's instructions and as indicated. Provide proper foundations for mounting of equipment, accessories, appurtenances, piping and controls including, but not limited to, supports, vibration isolators, stands, guides, anchors, clamps and brackets. Foundations, equipment rails and roof curbs for equipment shall conform to equipment manufacturer's recommendation, unless otherwise indicated on drawings. Locate equipment to allow working space for all necessary servicing such as component removal, disassembling compressors, replacing or adjusting drives, motors, access to automatic controls, refrigerant charging, lubrication, oil draining and general working clearance. Provide electric isolation between dissimilar metals for the purpose of minimizing galvanic corrosion.
- B. Rooftop Air Conditioning Units: Install system as indicated, in accordance with the requirements of ASHRAE 15, and as recommended in the manufacturer's installation and operational instructions.
  - 1. Ductwork: Provide in accordance with Specification Section 23 31 13, "Ductwork and Ductwork Accessories".
  - 2. Condensate Drain: Furnish and install external condensate drain piping and traps where required.



3. Natural gas piping, connections, valves and accessories shall be furnished and installed in accordance with below:
  - a. Gas Equipment Connectors:
    - 1) Flexible Connectors: ANSI Z21.45.
    - 2) Quick Disconnect Couplings: ANSI Z21.41.
    - 3) Semi Rigid Tubing and Fittings: ANSI Z21.69.
- C. Electrical Work: Electric motor-driven equipment specified herein shall be provided complete with motors, motor starters, and controls. Electrical equipment and wiring shall be in accordance with Division 26-Electrical. Provide manual or automatic control and protective devices required for the operation herein specified and any control wiring (120V or less) required for controls and devices but not indicated.
- D. Access Panels: Provide access panels for all concealed valves, controls, dampers, and other fittings requiring inspection and maintenance.
- E. Air Filters: Install air filters to allow access space for servicing the filters. Install filters with suitable sealing to prevent bypassing of air.

### 3.02 TESTING AND COMMISSIONING

- A. Tests: All tests shall be performed by and everything required for test shall be furnished by the Contractor, including personnel. Equipment and materials certified as having been successfully tested by the manufacturer in accordance with referenced specifications and standards will not require retesting before installation. Equipment and materials not tested at the place of manufacture shall be tested before or after installation, as applicable, where necessary to determine compliance with referenced specifications and standards.
  1. Prior to initial operation, inspect equipment installation for conformance with drawings and specifications. After preliminary tests and inspections, test, adjust and balance the air handling and distribution equipment in accordance with Section 23 05 93, "Testing and Balancing Air and Water Systems".
  2. Leak Testing: Upon completion of installation of the air conditioning equipment, test all factory- and field-installed refrigerant piping with an electronic-type leak detector to acquire a leak-tight refrigerant system. If leaks are detected at time of installation or during the guarantee period, remove the entire refrigerant charge from the system, correct the leaks, and retest the system.
  3. Evacuation, Dehydration, and Charging: After field charged refrigerant system is found to be without leaks or after leaks have been repaired on field-charged and factory-charged systems, evacuate the system using a reliable gage and a vacuum pump capable of pulling a vacuum of at least 1 mm Hg absolute. Evacuate system in accordance with the triple-evacuation and blotter method or, in accordance with equipment manufacturer's printed instructions. System leak testing, evacuation,

dehydration, and charging with refrigerant shall comply with the requirements contained in AHRI 260.

4. Startup and Operation Tests: Test the air conditioning systems and systems components for proper operation. Adjust safety and automatic control instruments as necessary to insure proper operation and sequence. The operational test shall be not less than 8 hours.

### 3.03 INSTRUCTION OF OPERATING PERSONNEL

- A. Upon completion of the work, and acceptance of the installation, and at a time designated by the Owner, the services of a competent technician regularly employed or authorized by the manufacturer of the compactor shall be provided for instructing personnel in the proper operation, maintenance, safety and emergency procedures. The period of instruction shall be not less than two hours. The training shall be conducted at the job site during actual operation and coordinated with the Owner one week in advance.

END OF SECTION

## SECTION 26 05 01

### ELECTRICAL GENERAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Electrical General Requirements, as shown on the Plans, as specified and/or directed.

##### 1.02 REFERENCES

- A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
  - 1. Federal Specification (Fed. Spec.):
    - a. L-P-387A - Plastic Sheet, Laminated, Thermosetting (for Design Plates)
  - 2. American National Standards Institute (ANSI) Publications:
    - a. C37.20 - Switchgear Assemblies, Including Metal-Enclosed Bus
    - b. Z35.1 - Accident Prevention Signs
  - 3. Institute of Electrical and Electronics Engineers (IEEE) Publication:
    - a. 100 - Standard Dictionary of Electrical and Electronics Terms
  - 4. National Electrical Manufacturers Association (NEMA) Publication:
    - a. ICS 6 - Enclosures for Industrial Controls and Systems
  - 5. National Fire Protection Association (NFPA) Publications:
    - a. 70B - Electrical Equipment Maintenance
    - b. 70 - National Electrical Code

##### 1.03 APPLICATION

- A. This Section applies to all sections of Division 26, "Electrical", of this project except as specified otherwise in each individual section.

##### 1.04 DEFINITION OF ELECTRICAL TERMS

- A. Unless otherwise specified or indicated, electrical terms used in these Specifications, and on the drawings, shall be as defined in IEEE Standard No. 100.

#### 1.05 ELECTRICAL UTILITY COORDINATION & ELECTRICAL SYSTEM VERIFICATION

- A. Contractor shall coordinate all pre and post construction activities with the Electrical Utility (EU) provider per the EUs written bulletin/specification requirements.
- B. Prior to shop drawing submittals, prior to commencing any demolition and/or prior to commencing any new construction activities, electrical characteristics for all existing and/or proposed electrical systems (including service, premises wiring systems and/or separately derived systems) shall be verified by this Contractor.
- C. The Contractor shall coordinate and confirm, in writing, the following information from the Electrical Utility prior to commencement of any work under this Contract:
  - 1. Voltage
  - 2. Number of phases
  - 3. Type of system grounding
  - 4. Metering arrangement and Style
  - 5. Electrical Service Capacity
- D. Should the Contractor's verification of any existing or proposed electrical system indicate a discrepancy with the Contract Documents, report them immediately to the Owner and/or Owners designated representative.
- E. Submitting shop drawings and/or commencing any work under this Contract prior to all electrical systems verification/confirmation as required above signifies that Contractor accepts all existing and proposed electrical system characteristics and conditions.

#### 1.06 SUBMITTALS

- A. Obtain approval before procurement, fabrication, or delivery of items to the job site. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable Federal, Military, industry, and technical society publication references, and other information necessary to establish contract compliance of each item to be furnished. Furnish a minimum of six (6) copies of shop drawings for each major device specified or electronic shop drawings as specified herein. All hard copy shop drawings shall be a minimum of 8.5 inches by 11 inches in size.
- B. Shop Drawings: In addition to the requirements specified elsewhere, shop drawings shall meet the following requirements. Drawings shall include complete ratings information, wiring diagrams, and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories,

pipng, ductwork, and other items that must be shown to assure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.

- C. **Manufacturer's Data:** Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.
- D. **Publication Compliance:** Where equipment or materials are specified to conform to industry and technical society publications of organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), and Underwriters' Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. In lieu of the label or listing, submit a certificate from an approved independent testing organization, adequately equipped and competent to perform such services, stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's publication.
- E. **Submittals Required:** Supply shop drawing submittal information as otherwise noted in each individual section.
- F. **Electronic Shop Drawings:** If allowed by other sections of these Contract Documents, electronic submittals shall be submitted to Engineer in accordance with procedures outlined in these Contract Documents, as established at a preconstruction meeting and/or per Engineer's written instructions.
  - 1. Electronic shop drawings shall be submitted in an OCR (searchable) PDF file format or per Engineer's instructions. Each shop drawing shall be a single electronic file with correct orientation of all sheets contained within.
  - 2. Electronic shop drawings shall be scaled to print at 8.5 inches by 11 inches (for general information, manufacturer's product data, etc.) and as required for drawings (layout drawings, coordination drawings, schematics, site drawings, electronic copy), except as specified otherwise.
  - 3. Engineer shall make final determination on clarity of electronic shop drawings and will reject electronic shop drawing if resolution is not acceptable.

## 1.07 OPERATION AND MAINTENANCE MANUAL

- A. Submit as required for systems and equipment indicated in the technical sections. Furnish three (3) copies, bound in hardback binders or an approved equivalent. Furnish one complete manual prior to performance of systems or equipment tests, and furnish the remaining manuals prior to contract completion. Inscribe the following identification on the cover: the words "OPERATION AND MAINTENANCE MANUAL", the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment. Include a table of contents and assemble the manual to conform to the table of contents, with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include:
1. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the system or equipment.
  2. A control sequence describing startup, operation, and shutdown.
  3. Description of the function of each principal item of equipment.
  4. Installation and maintenance instructions.
  5. Safety precautions.
  6. Diagrams and illustrations.
  7. Testing methods.
  8. Performance data.  
Lubrication schedule including type, grade, temperature range, and frequency.
  9. Parts list. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
  10. Appendix: List qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
- B. Electronic Version: Provide a complete O&M as a single PDF file, or multiple files if there are significant amounts of data. PDF file(s) shall be an optical character recognition (OCR) or searchable file.

## 1.08 SPARE PARTS

- A. Provide spare parts for all equipment installed under this Contract, as indicated in individual specification sections.

## 1.09 POSTED OPERATING INSTRUCTIONS

- A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave

operating instructions and frame under glass or in approved laminated plastic. Post instructions as directed. Attach or post operating instructions adjacent to each principal system and equipment including startup, proper adjustment, operating, lubrication, shutdown, safety precautions, procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each system or equipment. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

#### 1.10 INSTRUCTION TO OWNER'S PERSONNEL

- A. Where indicated in the technical sections, furnish the services of competent instructors to give full instruction to Owner's personnel in the adjustment, operation, and maintenance of systems and equipment, including pertinent safety requirements as required. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The number of man days (8 hours) of instruction furnished shall be as specified in each individual section.

#### 1.11 LAYOUT OF THE WORK

- A. Coordinate the proper relation of the work to the building structure, existing utilities and to the work of all trades. Visit the premises and become familiar with the dimensions in the field, and advise the Owner's Representative of any discrepancy before performing any work.
  - 1. Contract Drawings: The Contract Drawings represent the general intent as to layout and equipment arrangements. All locations and dimensions shown shall be field verified and minor alterations made if so required. Where dimensions are not given for the location and arrangement of mechanical systems, locations may be assumed to be approximate, and may be altered if required. Major modifications to the indicated arrangements shall be approved by the Owner's Representative prior to the installation of mechanical systems. Schematic diagrams represent the overall system requirements and do not necessarily indicate the physical orientation, location or dimensions of that system.
  - 2. Coordination Drawings: Each Contractor and/or his Subcontractor shall submit drawings showing the coordination of work between work of their respective trade and with the work of the other trades and structural and architectural elements of the work. Items to be shown on the drawings shall include, but are not limited to, ductwork systems, control dampers, HVAC piping, plumbing piping, plumbing fixtures, fire protection piping, sprinkler head layout, smoke detectors, heat detectors, light fixtures, electrical equipment, pull boxes, and conduit runs that utilize a 1-inch

diameter or larger conduit. Drawings shall be in sufficient detail to show overall dimensions of related items, clearances and relative location of work in the allotted spaces. Drawings shall indicate any routing changes that are required to be made to resolve clearance problems between the elements of various trades.

- a. Each Contractor and/or his Subcontractor shall be solely responsible for the generation of the coordination drawings including distribution to, and collection of related information from each Contractor or Subcontractor. Drawings shall be produced in AutoCAD format and submitted on sheets no larger than 24 x 36-inches. Upon written request, background drawings will be provided to the Contractor for the purpose of coordination drawing development. The Owner or Engineer does not warranty the accuracy of any background drawings provided and the Contractor shall be responsible to field verify all background drawings. Submit complete drawings to Engineer a minimum of one week prior to the intended start of the related construction.
3. Record Drawings: The Contractor shall maintain a record of the progress of the work and shall submit three (3) hard copy sets of As-Built Drawings upon completion of the project.

#### 1.12 DELIVERY AND STORAGE

- A. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B, Appendix I, titled "Equipment Storage and Maintenance During Construction". Replace damaged or defective items with new items.

#### 1.13 SPECIAL CONDITIONS

- A. When performing work within active areas, the Contractor shall be responsible to coordinate with the Owner regarding planned interruptions to electrical services and/or road access. Contractor must maintain in service the existing electrical services at the existing building unless otherwise coordinated with the Owner.
- B. Protection of Existing Work: The Contractor shall take all necessary precautions to ensure against damage to existing work to remain in place, or to be reused. The Contractor shall ensure that structural elements are not overloaded and additional structural supports required as a result of any cutting, removal or demolition work performed under any part of this Contract are added. Unless specified otherwise, the Contractor shall submit for review detailed shop drawings applicable to the Contract work for all structural supports, hangers and related devices, structural modifications, temporary rigging and associated rigging plans. Commencement of such work prior to the submission and review of applicable shop drawings shall be at the sole risk of the Contractor.



- C. Upon damage to existing equipment, buildings, and/or structures, the Contractor shall immediately notify the Owner. All damages shall be repaired by the Contractor, or shall be replaced if beyond repair, to match the existing to the Owner's satisfaction.
- D. Protection of Buildings from the Weather: The interior of the buildings and all materials and equipment shall be protected from the weather at all times.
- E. Protection of Personnel: Where the safety of non-contractor personnel is endangered in the area of the work, barricades shall be used. Additional protection shall be provided if required, to preserve the safety of non-contractor personnel in the immediate area of the work.
- F. Contractor shall maintain open road access at all times to the existing building. Contractor shall stage construction such that at least one lane of the existing access road is open at all times. Contractor shall coordinate with the Owner a minimum of one week prior to any planned road closings.
- G. Construction in Existing Buildings: Verify with Owner expected routing of new wire and/or conduit within existing equipment or buildings prior to field construction of systems. Coordinate with the Owner a minimum of ten (10) working days prior to any planned disruption of existing working systems.

#### 1.14 CATALOGED PRODUCTS/SERVICE AVAILABILITY

- A. Materials and equipment shall be current products by manufacturers regularly engaged in the production of such products. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The 2-year period shall be satisfactorily completed by a product for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished. The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the Contract.

#### 1.15 MANUFACTURER'S RECOMMENDATIONS

- A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material. Obtain manufacturer's

recommendations from the Owner for equipment and/or material provided by the Owner.

#### 1.16 MOTORS AND MOTOR CONTROLS FOR MECHANICAL EQUIPMENT

- A. The electrical components of mechanical equipment, such as motors, motor starters, control or push button stations, float or pressure switches, solenoid valves, and other devices functioning to control mechanical equipment, and control wiring and conduit for circuits rated 100 volts or less, are specified in the section covering the associated mechanical equipment, rather than in Division 26, unless otherwise shown. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, and the electrical power circuits shall be furnished and installed under Division 26 in accordance with other sections and/or as shown on the Contract Drawings.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS AND EQUIPMENT

- A. All materials, equipment, and devices shall, as a minimum, meet the requirements of UL where UL standards are established for those items, and the requirements of NFPA 70. All items shall be new unless specified or indicated otherwise.

#### 2.02 NAMEPLATES

- A. Fed. Spec. L-P-387. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the black core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be a minimum of 0.25-inch high normal block style.
- B. For sites with power generation equipment: Provide permanent nameplate at service entrance equipment indicating type and location of on-site generation power source (generator, PV, co-gen, etc.) in accordance with NEC Article 705. Provide same nameplate at generation sources main disconnect indication type and location of service entrance equipment.

## PART 3 - EXECUTION

### 3.01 NAMEPLATE MOUNTING

- A. Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.
- B. Provide nameplates for all equipment as required by other sections.
- C. Provide nameplates for all owner furnished equipment that is installed by this Contractor.

### 3.02 PAINTING OF EQUIPMENT

- A. Factory Applied: Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.

### 3.03 TESTS

- A. General: Perform and record all tests in the presence of the Owner's authorized representative and/or the Engineer. Furnish all instruments and personnel. Perform preliminary tests and correct all defective material and/or workmanship prior to witness of tests. Perform tests as indicated and as otherwise noted in other Sections of the Division 26.
- B. Conduct field tests in the sequence listed below:
  - 1. Insulation Resistance Tests: As required per individual specification sections.
- C. Load Balance Test: Make test by energizing all lighting, motors and other electrical equipment simultaneously for a three-hour period. Alter fuses, circuit breakers, circuit connections, etc., as required for satisfactory performance. Take voltage and amperage readings on each circuit at all panels.
- D. Check the amperage draw, voltage and direction of rotation of each motor in the presence of the equipment contractor and the Owner's representative. Make all necessary changes to obtain proper rotation, motor terminal voltage, motor protection, etc. Revise heater elements as necessary for proper motor protection. Similarly check all other electrically connected equipment.
  - 1. Make the test at a time during the day or night that is mutually satisfactory to the Owner at least one week prior to substantial completion. Make all arrangements and notify all parties in writing at least seventy-two hours prior to the test.

- E. Equipment Operation Test - Show by demonstration in service that all circuits are in good operating condition. Cycle all control equipment under load at least five times.
- F. Equipment and apparatus factory tests - Manufacturer's normal quality control tests are acceptable, unless specific factory witnessed tests are specified in other sections.
- G. Perform all other field tests as required in individual specification sections.

#### 3.04 CLEANING

- A. When directed, just prior to final acceptance, clean all equipment including, but not limited to, the following:
  - 1. Lighting fixtures, panelboards, control centers, switchgear, receptacles and switch plates - Remove all tags and labels; leave ready for use
  - 2. All equipment to be painted, removing all rust, etc., and leave ready for painting
  - 3. Building, by removing all debris, conduits, wire, insulation, cartons, etc., left as a result of this work.

#### 3.05 THIRD PARTY INSPECTION AND MISC SERVICES COORDINATION

- A. Contractor shall provide and pay for inspection of electrical work by an AHJ approved electrical inspection agency.
- B. Contractor shall coordinate with the Owner and the Telephone Company regarding telephone service requirements and connection.
- C. Contractor shall coordinate with the Owner and the Internet Provider regarding telephone service requirements and connection.
- D. Contractor shall coordinate with the Owner regarding connections to existing systems and work within existing buildings and equipment.

#### 3.06 WORK WITHIN EXISTING BUILDINGS

- A. Contractor shall install new feeder breakers in existing panels and shall install new conduit and wire systems within existing buildings. Contractor shall use care in installation of new work and shall protect existing work and finishes in his work area. Contractor shall immediately notify Owner of any damages to existing equipment or finishes and shall restore damaged items to Owner's satisfaction.

END OF SECTION

## SECTION 26 05 19

### WIRING/CABLE, 600 VOLTS AND UNDER

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Under this Section, the Contractor shall furnish all labor, materials, equipment and accessories for Wiring/Cable, 600 Volts and Under, as shown on the Plans, as specified and/or directed.
- B. For type MC cable, refer to Contract Drawings for areas where MC cable is allowed. MC cable shall be allowed only for branch circuit wiring (lighting and receptacles).

##### 1.02 REFERENCES

- A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only and shall be the most current version.
  - 1. National Electrical Manufacturers Association (NECA) Publication:
    - a. Standard of Installation
  - 2. International Electrical Testing Association (NETA) Publication:
    - a. ATS - Electrical Power Distribution Equipment and Systems
  - 3. National Fire Protection Association (NFPA) Publication:
    - a. 70 - National Electrical Code
  - 4. American Society for Testing and Materials (ASTM) Publications:
    - a. B1 - Hard-Drawn Copper Wire
    - b. B8 - Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
    - c. E14 - Fire Tests of Through-Penetration Fire Stops
  - 5. Underwriters Laboratories, Inc. (UL) Publications:
    - a. 854 - Service Entrance Cables
    - b. 486A - Wire Connector and Soldering Lugs for Use with Copper Conductors
    - c. 486C - Splicing Wiring Connectors
    - d. 1569 - Metal-Clad Cables

##### 1.03 SUBMITTALS

- A. Product Data: Catalog sheets, specifications and installation instructions.
- B. Specification required test results.

## 1.04 PRODUCT DELIVERY

- A. Mark and tag insulated conductors and cables for delivery to the site. Include:
  - 1. Contractor's name.
  - 2. Project title and number.
  - 3. Date of manufacture (month & year).
  - 4. Manufacturer's name.
  - 5. Environmental suitability information (listed or marked "sunlight resistant" where exposed to direct rays of sun; wet locations listed/marked for use in wet locations; other applications listed/marked suitable for the applications).

## PART 2 - PRODUCTS

### 2.01 INSULATED CONDUCTORS AND CABLES

- A. Date of Manufacture: No insulated conductor more than one year old when delivered to the site will be acceptable.
- B. Acceptable Companies: American Insulated Wire Corp., BICC General Cable Industries, Inc., Cerro Wire & Cable Co. Inc., Pirelli Cable Corp., Owl Cable Corp., or Southwire Co.
- C. Conductors: Annealed uncoated copper or annealed coated copper in conformance with the applicable standards for the type of insulation to be applied on the conductor. Conductor sizes No. 12 and larger shall be stranded.
- D. Types:
  - 1. Lighting and Power Wiring:
    - a. Insulation: Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THW, THWN, XHHW, or RHW, except that grounding wire may be Type TW. Where lighting fixtures require 90-degree C conductors, provide only conductors with 90-degree C insulation or better.
    - b. Metal-Clad Cable, NFPA 70 Article 334 Type MC:
    - c. Interlocked flexible galvanized steel armor sheath, conforming to UL requirements for type MC metal clad cable.
    - d. Insulated copper conductors, suitable for 600 volts, rated 90°C, one of the types listed in NFPA 70 Table 310-13 or of a type identified for use in Type MC cable.
    - e. Internal full size copper ground conductor with green insulation.
    - f. Acceptable Companies: AFC Cable Systems Inc., Coleman Cable Co.

- g. Connectors for MC cable: AFC Fitting Inc.'s AFC Series, Arlington Industries Inc.'s Saddle grip, or Thomas & Betts Co.'s Tite-Bite with anti-short bushings.
  - 1) MI: AFC Cable Systems' Type MI Cable, or BICC/Pyrotenax Mineral Insulated System 1850 Pyrotenax Cable:
    - a) Copper conductors.
    - b) Sheathing containing asbestos fibers shall not be used.

In corrosive areas where indicated on drawings, utilize the following:

    - c) PVC or HDPE jacketing (where shown on drawings).
    - d) 600 volt rating.
    - e) Fittings and accessories as required for a complete system to suit listing and installation conditions.
- 2. Class 1, 2, 3 Wiring: Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; and for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
- 3. VFD Cables: VFD equipment shall be wired from line side (for standalone VFDs) and load side of VFD (standalone VFDs and MCC VFDs) to motor utilizing VFD rated cable. Cable specifications are as follows:
  - a. 600V UL 1277 Type TC per 2005 NEC Article 336
  - b. Copper Conductors
  - c. Class B Stranding per ASTM
  - d. XLPE Insulation XHHW-2 Rated Circuit Conductors (14 AWG and larger)
  - e. 90°C Wet/Dry
  - f. Class I & II; Division 2 Hazardous Locations
  - g. Overall UL 1685 Vertical Tray Flame Test
  - h. IEEE 1202/383 Vertical Tray Flame Test
  - i. Overall Shield

## 2.02 CONNECTORS

### A. General:

- 1. Connectors specified are part of a system. Furnish connectors and components, and use specific tools and methods as recommended by connector manufacturer to form complete connector system.
- 2. Connectors shall be capable of continuous operation at the current rating of the cables on which they are used.
- 3. Connectors shall be UL 486 A listed, or UL 486 B listed for combination dual rated copper/aluminum connectors (marked AL7CU for 75 degrees C rated circuits and AL9CU for 90 degrees C rated circuits).

- B. Splices:
1. Spring Type:
    - a. Rated 105° C, 600V; Buchanan/Ideal Industries Inc.'s B-Cap, Electrical Products Div./3M's Scotchlok Type Y, R, G, B, O/B+, R/Y+, or B/G+, or Ideal Industries Inc.'s Wing Nuts or Wire Nuts.
    - b. Rated 150° C, 600V; Ideal Industries Inc.'s High Temperature Wire-Nut Model 73B, 59B.
  2. Indent Type with Insulating Jacket: Rated 105° C, 600V; Buchanan/Ideal Industries Inc.'s Crimp Connectors, Ideal Industries Inc.'s Crimp Connectors, Penn-Union Corp.'s Penn-Crimps, or Thomas & Betts Corp.'s STA-KON.
  3. Indent Type (Uninsulated): Anderson/Hubbell's Versa-Crimp, VERSAtile, Blackburn/T&B Corp.'s Color-Coded Compression Connectors, Electrical Products Div./3M's Scotchlok 10000, 11000 Series, Framatome Connectors/Burndy's Hydent, Penn-Union Corp.'s BCU, BBCU Series, or Thomas & Betts Corp.'s Compression Connectors.
  4. Connector Blocks: NIS Industries Inc.'s Polaris System, or Thomas & Betts Corp.'s Blackburn AMT Series.
  5. Resin Splice Kits: Electrical Products Div./3M's Scotchcast Brand Kit Nos. 82A Series, 82-B1 or 90-B1, or Scotchcast Brand Resin Pressure Splicing Method.
  6. Heat Shrinkable Splices: Electrical Products Div./3M's ITCSN, Raychem Corp.'s Thermofit Type WCS, or Thomas & Betts Corp.'s SHRINK-KON Insulators.
  7. Cold Shrink Splices: Electrical Products Div./3M's 8420 Series.
- C. Gutter Taps: Anderson/Hubbell's GP/GT with GTC Series Covers, Blackburn/T&B Corp.'s H-Tap Type CF with Type C Covers, Framatome Connectors/Burndy's Polytap KPU-AC, H-Crimpfit Type YH with CF-FR Series Covers, ILSCO's GTA Series with GTC Series Covers, Ideal Industries Inc.'s Power-Connect GP, GT Series with GIC covers, NSI Industries Inc.'s Polaris System, OZ/Gedney Co.'s PMX or PT with PMXC, PTC Covers, Penn-Union Corp.'s CDT Series, or Thomas & Betts Corp.'s Color-Keyed H Tap CHT with HTC Covers.
- D. Terminals: Nylon insulated pressure terminal connectors by Amp-Tyco/Electronics, Electrical Products Div./3M, Framatome Connectors/Burndy, Ideal Industries Inc., Panduit Corp., Penn-Union Corp., Thomas & Betts Corp., or Wiremold Co.
- E. Lugs:
1. Single Cable (Compression Type Lugs): Copper, 1 or 2 hole style (to suit conditions), long barrel; Anderson/Hubbell's VERSAtile VHCL, Blackburn/T&B Corp.'s Color-Coded CTL, LCN, Framatome Connectors/Burndy's Hylug YA, Electrical Products Div./3M Scotchlok 31036 or 31145 Series, Ideal Industries Inc.'s CCB or CCBL, NSI



- Industries Inc.'s L, LN Series, Penn-Union Corp.'s BBLU Series, or Thomas & Betts Corp.'s 54930BE or 54850BE Series.
- 2. Single Cable (Mechanical Type Lugs): Copper, one or 2 hole style (to suit conditions); Blackburn/T&B Corp.'s Color-Keyed Locktite Series, Framatome Connectors/Burndy's Qiklug Series, NSI Industries Inc.'s Type TL, Penn-Union Corp.'s VI-TITE Terminal Lug Series, or Thomas & Betts Corp.'s Locktite Series.
- 3. Multiple Cable (Mechanical Type Lugs): Copper, configuration to suit conditions; Framatome Connectors/Burndy's Qiklug Series, NSI Industries Inc.'s Type TL, Penn-Union Corp.'s VI-TITE Terminal Lug Series, or Thomas & Betts Corp.'s Color-Keyed Locktite Series.

## 2.03 TAPES

- A. Insulation Tapes:
  - 1. Plastic Tape: Electrical Products Div./3M's Scotch Super 33+ or Scotch 88, Plymouth Rubber Co.'s Plymouth/ Bishop Premium 85CW.
  - 2. Rubber Tape: Electrical Products Div./3M's Scotch 130C, or Plymouth Rubber Co.'s Plymouth/Bishop W963 Plysafe.
- B. Moisture Sealing Tape: Electrical Products Div./3M's Scotch 2200 or 2210, or Plymouth Rubber Co.'s Plymouth/Bishop 4000 Plyseal-V.
- C. Electrical Filler Tape: Electrical Products Div./3M's Scotchfil, or Plymouth Rubber Co.'s Plymouth/Bishop 125 Electrical Filler Tape.
- D. Color Coding Tape: Electrical Products Div./3M's Scotch 35, or Plymouth Rubber Co.'s Plymouth/Bishop Premium 37 Color Coding.
- E. Arc Proofing Tapes:
  - 1. Arc Proofing Tape: Electrical Products Div./3M's Scotch 77, Mac Products Inc.'s AP Series, or Plymouth Rubber Co.'s Plymouth/Bishop 53 Plyarc.
  - 2. Glass Cloth Tape: Electrical Products Div./3M's Scotch 27/Scotch 69, Mac Products Inc.'s TAPGLA 5066,, or Plymouth Rubber Co.'s Plymouth/Bishop 77 Plyglas.
  - 3. Glass-Fiber Cord: Mac Products Inc.'s MAC 0527.

## 2.04 WIRE-PULLING COMPOUNDS

- A. To suit type of insulation; American Polywater Corp.'s Polywater Series, Electric Products Div./3M's WL, WLX, or WLW, Greenlee Textron Inc.'s Y-ER-EAS, Cable Cream, Cable Gel, Winter Gel, Ideal Industries Inc.'s Yellow 77, Aqua-Gel II, Aqua-Gel CW, or Thomas & Betts Corp.'s Series 15-230 Cable Pulling Lubricants, or Series 15-631 Wire Slick.

## 2.05 TAGS

- A. Precision engrave letters and numbers with uniform margins, character size minimum 3/16 inch high.
- B. Phenolic: Two color laminated engraver's stock, 1/16 inch minimum thickness, machine engraved to expose inner core color (white).
- C. Aluminum: Standard aluminum alloy plate stock, minimum .032 inch thick, engraved areas enamel filled or background enameled with natural aluminum engraved characters.

## 2.06 WIRE MANAGEMENT PRODUCTS

- A. Cable Clamps and Clips, Cable Ties, Spiral Wraps, etc: Catamount/T&B Corp., or Ideal Industries Inc.

# PART 3 - EXECUTION

## 3.01 INSTALLATION

- A. Install conductors in raceways after the raceway system is completed.  
Exceptions: Type TC, MI, or other type specifically indicated on the drawings not to be installed in raceways.
- B. No grease, oil, or lubricant other than wire-pulling compounds specified may be used to facilitate the installation of conductors. Completely and thoroughly swab raceway/wire before installing wire/cable.
- C. All splices and connections shall be made in accessible boxes and cabinets only.

## 3.02 CIRCUITING

- A. Wiring and cables of different systems shall not be run in same raceway. Power wiring shall not be run in same raceway for remote control/signal wiring.
- B. Class 2, 3 plenum rated cables shall be run without raceway when concealed above accessible ceilings unless otherwise indicated on Contract Drawings. These cables shall be run parallel and perpendicular to building surfaces, and shall be neatly bundled and shall be supported independently from the accessible ceiling utilizing bridle rings or similar. Cables shall effectively be routed horizontal. Provide conduit sleeves at wall penetrations.

## 3.03 COMMON NEUTRAL CONDUCTOR

- A. A common neutral shall not be used. Provide individual neutral per each circuit.

### 3.04 COLOR CODING

- A. Color Coding for 120/208/240 Volt Electric Light and Power Wiring:
1. Color Code:
    - a. 2 wire circuit - black, white.
    - b. 3 wire circuit - black, red, white.
    - c. 4 wire circuit - black, red, blue, white.
  2. White to be used only for an insulated grounded conductor (neutral). If neutral is not required use black and red, or black, red and blue for phase to phase circuits.
    - a. "White" for Sizes No. 6 AWG or Smaller:
      - 1) Continuous white outer finish, or:
      - 2) Three continuous white stripes on other than green insulation along its continuous length.
    - b. "White" for Sizes Larger Than No. 6 AWG:
      - 1) Continuous white outer finish, or:
      - 2) Three continuous white stripes on other than green insulation along its continuous length, or:
      - 3) Distinctive white markings (color coding tape) encircling the conductor, installed on the conductor at time of its installation. Install white color coding tape at terminations, and at 1' 0" intervals in gutters, pull boxes, and manholes.
  3. Colors (Black, Red, Blue):
    - a. For Branch Circuits: Continuous color outer finish.
    - b. For Feeders:
      - 1) Continuous color outer finish, or:
      - 2) Color coding tapes encircling the conductors, installed on the conductors at time of their installation. Install color coding tapes at terminations, and at 1' 0" intervals in gutter, pull boxes, and manholes.
- B. Color Coding For 277/480 Volt Electric Light and Power Wiring:
1. Color Code:
    - a. 2 wire circuit – brown, gray.
    - b. 3 wire circuit – brown, yellow, gray.
    - c. 4 wire circuit – brown, orange, yellow, gray.
  2. Gray to be used only for an insulated grounded conductor (neutral). If neutral is not required use brown and yellow, or brown, yellow and orange for phase to phase circuits.
    - a. "Gray" For Sizes No. 6 AWG or Smaller:
      - 1) Continuous gray outer finish.
    - b. "Gray" For Sizes Larger Than No. 6 AWG:
      - 1) Distinctive gray markings (color coding tape) encircling the conductor, installed on the conductor at time of its installation. Install gray color coding tape at terminations, and at 1' 0" intervals in gutters, pull boxes, and manholes.

- c. Colors (Brown, Yellow, Orange):
- d. For Branch Circuits: Continuous color outer finish.
- e. For Feeders:
  - 1) Continuous color outer finish, or:
  - 2) Color coding tapes encircling the conductors, installed on the conductors at the time of their installation. Install color coding tapes at terminations, and at 1' 0" intervals in gutters, pull boxes, and manholes.
- C. More Than One Nominal Voltage System Within A building: Permanently post the color coding scheme at each branch-circuit panelboard.
- D. Existing Color Coding Scheme: Where an existing color coding scheme is in use, match the existing color coding if it is in accordance with the requirements of NFPA 70.
- E. Color Code For Wiring Other Than Light and Power: In accordance with ICEA/NEMA WC-30 "Color Coding of Wires and Cables". Other coding methods may be used, as approved.
- F. On 3-phase, 4-wire delta system, high leg shall be orange, as required by NFPA 70.

### 3.05 IDENTIFICATION

- A. Identification Tags: Use tags to identify feeders and designated circuits. Install tags so that they are easily read without moving adjacent feeders or requiring removal of arc proofing tapes. Attach tags with non-ferrous wire or brass chain.
  - 1. Interior Feeders: Identify each feeder in pull boxes and gutters. Identify by feeder number and size.
  - 2. Exterior Feeders: Identify each feeder in manholes and in interior pull boxes and gutters. Identify by feeder number and size, and also indicate building number and panel designation from which feeder originates.
  - 3. Street and Grounds Lighting Circuits: Identify each circuit in manholes and lighting standard bases. Identify by circuit number and size, and also indicate building number and panel designation from which circuit originates.
- B. Identification Plaque: Where a building or structure is supplied by more than one service, or has any combination of feeders, branch circuits, or services passing through it, install a permanent plaque or directory at each service, feeder and branch circuit disconnect location denoting all other services, feeders, or branch circuits supplying that building or structure or passing through that building or structure and the area served by each.

- C. All control conductors as specified herein shall be labeled at each termination point. Labeling shall be permanently labeled with printed Brady type labels or equivalent.

### 3.06 WIRE MANAGEMENT

- A. Use wire management products to bundle, route, and support wiring in junction boxes, pull boxes, wireways, gutters, channels, and other locations where wiring is accessible.

### 3.07 EQUIPMENT GROUNDING CONDUCTOR

- A. Install Equipment Grounding Conductor:
  - 1. Where specified in other Sections or indicated on the Contract Drawings.
  - 2. In conjunction with circuits recommended by equipment manufacturers to have equipment grounding conductor.
- B. Equipment grounding conductor is not intended as a current carrying conductor under normal operating circumstances.
- C. Color Coding For Equipment Grounding Conductor:
  - 1. Color Code: Green.
  - 2. "Green" For sizes No. 6 AWG or Smaller:
    - a. Continuous green outer finish, or:
    - b. Continuous green outer finish with one or more yellow stripes, or:
    - c. Bare copper (see exception below).
  - 3. "Green" For Sizes Larger Than No. 6:
    - a. Stripping the insulation or covering from the entire exposed length (see exception below).
    - b. Marking the exposed insulation or covering with green color coding tapes.
    - c. Identify at each end and at every point where the equipment grounding conductor is accessible.
  - 4. Exception For use of Bare Copper: Not allowed for use where NFPA 70 specifically requires equipment grounding conductor to be insulated, or where specified in other sections or indicated on the drawings to be insulated.

### 3.08 SPECIAL GROUNDING CONDUCTORS

- A. Technical Power System Grounding (Equipment grounding conductor isolated from the premises grounded conductor except at a single grounded termination point): Install an insulated grounding conductor running with the circuit conductors for isolated receptacles or utilization equipment requiring an isolated ground.
  - 1. Color Code: Green.

2. “Green” For Isolated Grounding Conductor:
  - a. Continuous green outer finish, or:
  - b. Continuous green outer finish with one or more yellow stripes, and:
  - c. Different than the “green” used for the equipment grounding conductor run with the circuit (where required).
3. Install label at every point where the conductor is accessible, identifying it as an “Isolated Grounding Conductor”.

### 3.09 ARC PROOFING

- A. Arc proof 600V and under cables only where routed in a manhole/handhole that also contains medium voltage cable/feeders as follows:
  1. Arc proof new 600V and under cables.
  2. Arc proof existing 600V and under cables that are spliced to new 600V and under cables.
  3. Arc proof each 600V and under cable as a unit (except cables consisting of multiple sets of conductors).
  4. Arc proof 600V and under cables consisting of multiple sets of conductors by arc proofing each set of conductors as a unit.
  5. Arc proof with half-lapped layer of 55 mils thick arc proofing tape and random wrapped or laced with glass cloth tape or glass-fiber cord. For arc proofing tape less than 55 mils thick, add layers to equivalent of 55 mils thick arc proofing tape.

### 3.10 INSULATED CONDUCTOR AND CABLE SCHEDULE - TYPES AND USE

- A. Electric Light and Power Circuits:
  1. FEP, THHN, THW, THW-2, THWN, THWN-2, XHH, XHHW, or XHHW-2: Wiring in dry or damp locations (except where special type insulation is required).
  2. THWN, THWN-2, XHHW, XHHW-2, USE, or USE-2: Wiring in wet locations (except where type USE or USE-2 insulated conductors are specifically required, or special type insulation is required).
  3. THHN, THWN or THWN-2: Wiring installed in existing raceway systems (except where special type insulation is required).
  4. THHN, THW-2, THWN-2, XHHW, or XHHW-2: Wiring for electric discharge lighting circuits (fluorescent, HID), except where fixture listing requires wiring rated higher than 90° C.
  5. THWN Marked “Gasoline and Oil Resistant”: Wiring to gasoline and fuel oil pumps.
  6. USE, or USE-2: Wiring indicated on the drawings to be direct burial in earth.
  7. USE, or USE-2 Marked “Sunlight Resistant”:
    - a. Service entrance wiring from overhead service to the service equipment.

- b. Wiring exposed to the weather and unprotected (except where special type insulation is required).
  - 8. MC: Where allowed for 120V, 20A max circuits per the Contract Drawings or part as specified herein:
    - a. Branch circuit wiring in wood framed construction (wood joists and wood stud partitions):
      - 1) Install conductors parallel with joists or studs and attach to the side of these timbers by galvanized straps spaced not more than 6 feet apart.
      - 2) Install conductors through holes bored in the center of the timbers when running at right angles to joists or studs.
      - 3) Do not attach the conductors to the edge of joists or studs.
    - b. Branch circuit wiring in movable metal partitions and movable gypsum partitions.
      - 1) Install conductors in accordance with partition manufacturer's recommendations.
    - c. Branch circuit wiring in metal stud partitions:
      - 1) Install conductors parallel with studs and attach to the side by galvanized straps spaced not more than 6 feet apart.
      - 2) Install conductors through holes bored in the center of the metal member when running at right angles to studs.
    - d. Conductors shall be protected by listed bushings or listed grommets covering all metal edges.
      - 1) Do not attach the conductors to the edge of studs.
  - 9. MI:
  - 10. Wiring for underplaster extensions.
  - 11. Wiring in areas where indicated on the Contract Drawings.
  - 12. Where MI cable is installed in areas subjecting cable to corrosion, use PVC or HDPE jacketed MI cable (nonmetallic jacketed cable is not suitable for use in ducts, plenums or other spaces used for environmental air).

- B. Emergency Feeder Circuits: Use electrical circuit protective system.
- C. Class 1 Circuits: Use Class 1 wiring specified in Part 2 (except where special type insulation is required).
- D. Class 2 Circuits: Use Class 2 wiring specified in Part 2 (except where special type insulation is required).
- E. Class 3 Circuits: Use Class 3 wiring specified in Part 2 (except where special type insulation is required).

### 3.11 CONNECTOR SCHEDULE - TYPES AND USE

- A. Temperature Rating: Use connectors that have a temperature rating, equal to, or greater than the temperature rating of the conductors to which they are connected.

- B. Splices:
1. Dry Locations:
    - a. For Conductors No. 8 AWG or Smaller: Use spring type pressure connectors, indent type pressure connectors with insulating jackets, or connector blocks (except where special type splices are required).
    - b. For Conductors No. 6 AWG or Larger: Use connector blocks or uninsulated indent type pressure connectors. Fill indentions in uninsulated connectors with electrical filler tape and apply insulation tape to insulation equivalent of the conductor, or insulate with heat shrinkable splices or cold shrink splices.
    - c. Gutter Taps in Panelboards: For uninsulated type gutter taps fill indentions with electrical filler tape and apply insulation tape to insulation equivalent of the conductor, or insulate with gutter tap cover.
  2. Damp Locations: As specified for dry locations, except apply moisture sealing tape over the entire insulated connection (moisture sealing tape not required if heat shrinkable splices or cold shrink splices are used).
  3. Wet Locations: Use uninsulated indent type pressure connectors and insulate with resin splice kits, cold shrink splices or heat shrinkable splices. Exception: Splices aboveground which are totally enclosed and protected in NEMA 3R, 4, 4X enclosures may be spliced as specified for damp locations.
- C. Terminations:
1. For Conductors No. 10 AWG or Smaller: Use terminals for:
    - a. Connecting wiring to equipment designed for use with terminals.
  2. For Conductors No. 8 AWG or Larger: Use compression or mechanical type lugs for:
    - a. Connecting cables to flat bus bars.
    - b. Connecting cables to equipment designed for use with lugs.
  3. For Conductor Sizes Larger Than Terminal Capacity On Equipment: Reduce the larger conductor to the maximum conductor size that terminal can accommodate (reduced section not longer than one foot). Use compression or mechanical type connectors suitable for reducing connection.

### 3.12 TESTING

- A. Insulation Resistance Tests: Make tests after all wiring is completed and connected ready for the attachment of fixture and/or equipment. Repeat test when all fixtures and/or equipment are connected ready for use. Make tests with an instrument capable of measuring the resistance involved at a voltage of at least 500 VDC for equipment rated at 100 to 500 VAC, 1500 VDC for equipment rated at 151 to 600 VAC. Apply voltage continuously for one minute prior to taking



reading. Measure insulation resistance between each pair of insulated conductor separately and between each insulated conductor and ground. Make tests at each panelboard distribution panel, and switchboard on every circuit with the circuit protective device open but connected. The minimum acceptable measured insulation resistance for wiring completed and ready for connection of fixtures and/or equipment is 50 meg ohms.

END OF SECTION

## SECTION 26 05 26

### GROUNDING

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Grounding and bonding of electrical installations as shown on the Plans, as specified and/or directed.
- B. Existing site conditions may necessitate use of alternative grounding systems to achieve required ohm values. Existing site conditions are to include minimum soil cover over bedrock and exposed bedrock.

##### 1.02 REFERENCES

- A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
  - 1. American National Standards Institute (ANSI), Electronic Industries Alliance (EIA), Telecommunications Industry Association (TIA)  
Publication: (ANSI/EIA/TIA)
    - a. 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications
  - 2. Institute of Electrical and Electronics Engineers (IEEE) Publications:
    - a. 81 - Guide for Measuring Earth Receptivity, Ground Impedance and Earth Surface Potential of a Ground System
    - b. 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems
    - c. 1100 - Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
  - 3. National Fire Protection Association (NFPA) Publication:
    - a. 70 - National Electrical Code (NEC)
  - 4. Underwriters Laboratories, Inc. (UL) Publications:
    - a. 83 - Thermoplastic-Insulated Wires and Cables
    - b. 44 - Rubber-Insulated Wires and Cables
    - c. 467 - Grounding and Bonding Equipment

##### 1.03 SUBMITTALS

- A. Product Data. Provide data for grounding electrodes and connectors.
- B. Test Reports: Indicate overall resistance to ground.

- C. Manufacturer's Instructions: Include instructions for preparation, installation and examination of exothermic connectors, as applicable.
- D. Certifications: Two weeks prior to final inspection, deliver to the Owner's designated representative four copies of the certification that the material and installation is in accordance with the drawings and specifications and has been properly installed.

## PART 2 - PRODUCTS

### 2.01 GROUNDING WIRES

- A. General Purpose: UL and NEC approved types, copper, with TW, THW, XHHW or dual rated THHN-THWN insulation color identified green.
- B. Isolated Power System: Type XHHW insulation with a dielectric constant of 3.5 or less.
- C. Size wire not less than what is shown and not less than required by the NEC.
- D. Stranded bare copper ground conductor where indicated on drawings.

### 2.02 GROUND RODS

- A. Copper clad steel, 3/4-inch diameter by 10 feet long.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Ground as shown and as hereinafter specified in accordance with the NEC.
- B. System Grounding:
  - 1. Ground the electrical service system neutral at service entrance equipment to grounding electrodes. Concrete encased electrodes shall be connected as the most effective grounding electrodes. Provide a completely grounded system in accordance with Article 250 of the NEC.
  - 2. Ground each separately-derived system neutral to separate grounding electrode system. Transformer, UPS systems, power conditioners, inverters, or other power supplies are separately derived systems. Standby or emergency generators are separately derived systems if the neutral is bonded to the generator frame and if there is no direct connection of the generator neutral conductor to the service neutral conductor.
  - 3. Provide communications system grounding conductor connected to separate electrode (ground bus) that is shall be installed in each IT room. Bond together system neutrals, service equipment enclosures, exposed

non-current carrying metal parts of electrical equipment, metal raceway systems, cable trays, auxiliary gutters, meter fittings, boxes, cable armor, cable sheath, ground bus in electrical rooms and IT rooms, metal frame of the building or structure, ground ring, lightning down lead conductor, grounding conductor in raceways and cables, receptacle ground connectors, and metal underground water pipe. Bonding jumpers shall be installed around non-metal fittings or insulating joints to ensure electrical continuity. Bonding shall be provided where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed.

4. Secondary service neutrals ground at the supply side of the secondary disconnecting means and at the related transformers.
5. Separately derived systems (transformers downstream from the service entrance) ground the secondary neutral.
6. Isolation transformers and isolated power systems shall not be system grounded.

C. Equipment Grounding:

1. Metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be grounded for personnel safety and to provide a low impedance path for possible ground fault currents.

### 3.02 PRIMARY EQUIPMENT AND CIRCUITS

- A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to a grounding electrode system, metal underground water pipe and driven ground rods for the grounding electrode. Where a new foundation/footer is constructed for a building/structure the grounding electrode system shall also be bonded to the concrete-encased electrode (reinforcing steel in foundation/footer). Coordinate with General Contractor.
- B. Duct Banks and Manholes:
1. Provide a bare equipment grounding conductor in each duct bank containing medium or high voltage cables. Connect the grounding conductors to the switchgear ground bus, to all manhole hardware, to the cable shielding of medium or high voltage cable splices and terminations, and equipment enclosures.
  2. Provide a grounding conductor having at least 50 percent ampacity of the largest phase conductor in the duct bank.
  3. Connect the equipment grounding conductor to the ground rod.
- C. Outdoor Fences: Connect outdoor fences around electrical equipment to the grounding electrode system.

- D. Metallic Conduit: Metallic conduits which terminate without mechanical connection to a housing of electrical equipment by means of locknut and bushings or adapters, provided with grounding bushings. Connect bushings with a bare grounding conductor to the equipment ground bus.
- E. Lightning Arresters: Connect lightning arrester grounds to the equipment ground bus, or ground rods as applicable.

### 3.03 SECONDARY EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Connect the secondary service neutral to the ground bus in the service equipment.
- B. Water Pipe and Supplemental Electrode:
  - 1. Provide a ground conductor connection between the service equipment ground bus and the metallic water pipe system. Jumper insulating joints/meter in the water pipe.
  - 2. Provide a supplemental ground electrode and bond to the water pipe ground, or connect to the service equipment ground bus.
  - 3. Where a new foundation/footer is constructed for a building/structure, the grounding electrode system shall also be bonded to the concrete-encased electrode (reinforcing steel in foundation/ footer). Coordinate with General Contractor.
- C. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.
- D. Switchgear and Switchboards:
  - 1. Connect the various feeder green grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
  - 2. Connect the grounding electrode conductor to the ground bus.
  - 3. Connect the neutral to the ground bus (main bonding jumper).
  - 4. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and ground wire to the ground bus.
- E. Conduit Systems:
  - 1. Ground all metallic conduit systems.
  - 2. Non-metallic conduit systems shall contain a grounding conductor.
  - 3. Conduit provided for mechanical protection containing only a grounding conductor, bond to that conductor at the entrance and exit from the conduit.

- F. Feeders and Branch Circuits: Install green grounding conductors with feeders and branch circuits as follows:
1. Feeders.
  2. Branch Circuits.
  3. Receptacle Outlets.
  4. Directly Connected Equipment, Appliances and Devices.
  5. Motors and Motor Controllers.
  6. Fixed Equipment and Appurtenances.
  7. Items of equipment where the final connection is made with flexible metal conduit shall have a grounding wire.
  8. Additional locations and systems as shown.
- G. Boxes, Cabinets, Enclosures and Panelboards:
1. Bond the grounding wires to each pull box, junction box, outlet box, cabinets, and other enclosures through which the ground wires pass.
  2. Provide lugs in each box and enclosure for ground wire termination.
  3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs for terminating the ground wires.
- H. Motors and Starters:
1. Provide lugs in motor terminal box and starter housing for ground wire termination.
  2. Make ground wire connections to ground bus in motor control centers.
- I. Receptacles are not approved for grounding through their mounting screws. Ground with a ground wire from green ground terminal on the receptacle to the outlet box ground screw.
- J. Ground lighting fixtures to the green grounding conductor of the wiring system. During renovation, provide the green ground if it is not part of the system, or ground the fixtures through the conduit systems per means acceptable under the NEC. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- K. Fixed electrical appliances and equipment shall have a ground lug installed for termination of the green ground conductor.

### 3.04 CONDUCTIVE PIPING

- A. Bond all conductive piping systems in the building to the electrical system ground. Bonding connections shall be made as close as practical to the water pipe ground or service equipment ground bus.

### 3.05 GROUND RESISTANCE

- A. Grounding system ground resistance must comply with NEC. Provide additional ground rods as required until resistance reading is compliant with NEC.
- B. Services at power company interface points shall comply with the power company ground resistance requirements.
- C. Make necessary modifications to the ground electrodes for compliance that is needed without additional cost to the Owner, including the provisions of a multi-rod system.

### 3.06 GROUND ROD INSTALLATION

- A. Drive each rod vertically in the earth for not less than ten feet in depth.
- B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- C. Where rock prevents the driving of vertical ground rods, install grounding electrodes in horizontal trenches to achieve the specified resistance.
- D. In manhole, install ground rods with 4 to 6 inches above the floor with connections of grounding conductors fully visible and accessible.

END OF SECTION

## SECTION 26 05 34

### CONDUIT

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Conduit as shown on the Plans, as specified, and/or directed.

##### 1.02 REFERENCES

- A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
  - 1. American National Standards Institute (ANSI) Publications:
    - a. C80.1 - Rigid Steel Conduit, Zinc Coated
    - b. C80.3 - Electrical Metallic Tubing, Zinc Coated
    - c. C80.5 - Rigid Aluminum Conduit
  - 2. National Electrical Manufacturers Association (NEMA) Publications:
    - a. FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
    - b. RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
    - c. TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
    - d. TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
  - 3. National Electrical Contractors Association (NECA) Publication:
    - a. Standard of Installation

##### 1.03 SECTION INCLUDES

- A. Rigid steel conduit.
- B. PVC coated rigid steel conduit.
- C. Flexible metal conduit.
- D. Liquid-tight flexible metal conduit.
- E. Electrical metallic tubing.
- F. Nonmetallic conduit.
- G. Flexible nonmetallic conduit.



- H. Electrical nonmetallic tubing.
- I. Fittings and conduit bodies.

#### 1.04 RELATED SECTIONS

- A. Section 26 05 01, "Electrical General Requirements", applies to this Section with additions and modifications specified herein.

#### 1.05 SUBMITTALS

- A. Conduit and fittings (each type).

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

#### 1.07 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on the Contract Drawings.
- B. Field verify all conduit routing and coordinate proposed conduit routing with all existing equipment, structure features, proposed equipment locations for equipment furnished by this Contractor and all other Contractors, Owner furnished equipment, etc. prior to rough-in.
- C. Conduit routing, when shown on the Contract Drawings, are in approximate locations unless dimensioned. Route as required to complete wiring system.
- D. Plans (drawings) are diagrammatic and show only approximate locations of equipment, fixtures, devices, etc. Plans may not show exact quantity and locations of junction and pull boxes required for a complete installation. Exact locations and routing of conduit shall be determined in the field and shall suit the job conditions. Quantities and locations of outlet, junction, and pull boxes shall be provided to suit the installed arrangement and meet all NEC and local code requirements.

#### 1.08 QUALITY ASSURANCE

- A. In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears.
- B. Verify routing and termination locations of conduit prior to rough-in.

- C. Conduit routing when shown on the Contract Drawings are in approximate locations unless dimensioned. Route as required to complete wiring system.

## 1.09 QUALITY ASSURANCE

- A. In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word “shall” has been substituted for “should” wherever it appears.

## PART 2 - PRODUCTS

### 2.01 MATERIALS AND EQUIPMENT

- A. Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for these items, and requirements of NFPA 70.
- B. Provide conduit types in specific installations as scheduled on Contract Drawings. Specific conduit material and installation specifications for the scheduled conduit type are specified herein.

### 2.02 CONDUIT AND FITTINGS

- A. Rigid Steel Conduit (Zinc-coated): ANSI C80.1, UL 6.
- B. Rigid Aluminum Conduit: ANSI C80.5, UL 6.
- C. Rigid Nonmetallic Conduit: UL 651, UL 1684
  - 1. PVC Type EPC-40 and EPC-80, in accordance with NEMA TC2.
  - 2. Fiberglass conduit in accordance with NEMA TC14.
- D. Intermediate Metal Conduit (IMC): UL 1242, zinc-coated steel only.
- E. Electrical Metallic Tubing (EMT): UL 797, ANSI C80.3.
- F. Electrical Nonmetallic Tubing (ENT): NEMA TC13.
- G. Plastic-coated Rigid Steel and IMC Conduit: NEMA RN1, Type 40 (40 mils thick).
- H. Flexible Metal Conduit: UL 1.
  - 1. Liquid-tight Flexible Metal Conduit, Steel: UL 360.
- I. Fittings for Metal Conduit, EMT, and Flexible Metal Conduit: UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B. Fittings shall match conduit type and material.

1. Fittings for Rigid Metal Conduit and IMC: Threaded-type. Split couplings unacceptable.
  2. Fittings for EMT: set screw type.
  3. Fittings for Use in Hazardous Locations: UL 886.
- J. Fittings for Rigid Nonmetallic Conduit: NEMA TC3. Fittings shall match conduit type and material.

## 2.03 FIBER OPTIC SYSTEMS

- A. For conduit systems that are intended for the installation of fiber optic cables, all conduit bends radii shall meet or exceed minimum radius in accordance with installed fiber optic bending limitation specifications.
- B. Where conduit bodies are used in 90 degree sections of conduit runs, only "Optical LB", or equivalent shall be used.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.
- B. Underground Service: Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.
- C. Overhead Service: Overhead service conductors into buildings shall terminate at service entrance fittings or weatherhead outside building. Overhead service conductors and support bracket for overhead conductors are included in the Section 26 05 41, "Overhead Electrical Work".
- D. Hazardous Locations: Work in hazardous locations, as defined by NFPA 70, shall be performed in strict accordance with NFPA 70 for particular "Class", "Division", and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Conduit shall have tapered threads.
- E. Service Entrance Identification: Service entrance disconnect devices, switches, or enclosures shall be labeled or identified as such.
1. Labels: Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect

devices. Provide laminated plastic labels. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure shall be provided only as permitted by NFPA 70.

- F. Wiring Methods: Provide insulated conductors installed in conduit, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Provide insulated, green equipment grounding conductor in feeder and branch circuits, including lighting circuits. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated, green conductor for grounding conductors installed in conduit or raceways. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 inches. Conduit which penetrates fire walls, fire partitions, or floors shall be metallic on both sides of fire walls, fire partitions, or floors for minimum distance of 6 inches.
1. Aluminum Conduit: Do not install underground or encase in concrete. Do not use brass or bronze fittings.
  2. Restrictions Applicable to EMT:
    - a. Do not install underground.
    - b. Do not encase in concrete.
    - c. Do not use in areas subject to severe physical damage.
    - d. Do not use in hazardous areas.
    - e. Do not use outdoors.
  3. Nonmetallic Conduit: Conduit shall not penetrate fire walls, fire partitions, or floors.
  4. ENT: ENT may be provided in walls, floors, and ceilings only when protected by thermal barriers identified as having minimum 15-minute finish rating. If ENT is used, provide required thermal barriers, whether indicated or not.
    - a. Following restrictions apply to ENT:
    - b. Do not route exposed.
    - c. Do not route above suspended ceilings (i.e., between suspended ceilings and permanent ceilings).
    - d. Do not use in feeder circuits.
    - e. Do not install underground.
    - f. Do not encase in concrete.

- g. Do not use in areas subject to severe physical damage including, but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.
- h. Do not use in hazardous areas.
- i. Do not use outdoors.
- j. Do not use in sizes larger than 2 inches.
- k. Do not use in penetrating fire rated walls, partitions, etc.
- 5. Restrictions applicable to PVC Schedule 40 and PVC Schedule 80.
  - a. Do not use in feeder circuits unless otherwise indicated.
  - b. Do not use in areas subject to severe physical damage including, but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.
  - c. Do not use in hazardous areas.
  - d. Do not use in penetrating fire-rated walls or partitions, fire rated floors, etc.
- 6. Service Entrance Conduit, Overhead: Rigid steel or IMC from service entrance to service entrance fitting or weatherhead outside building.
- 7. Service Entrance Conduit, Underground: Galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.
- 8. Underground Conduit Other Than Service Entrance: Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40; or fiberglass. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab; plastic coating shall extend minimum 6 inches above floor.
- 9. Conduit in Floor Slabs: Rigid steel; steel IMC; fiberglass, or PVC, Type EPC-40.
- 10. Conduit Interior to Buildings for 400 Hz Circuits: Aluminum or nonmetallic. Where 400-Hz circuit runs underground or through concrete, conduit shall be PVC Schedule 80.
- 11. Conduit for Circuits Rated Greater Than 600 Volts: Rigid metal conduit or IMC only.

G. Conduit Installation: Unless indicated otherwise, conceal conduit within finished walls (existing or proposed), above ceilings, below floors or within floor slabs. With written approval by the Owner's Designated Representative where conduit cannot physically be installed concealed, install decorative surface metal raceway as manufactured by Wiremold Series 2400, or approved equal.

- 1. For new conduit runs in existing locations, Contractor to field verify all proposed locations prior to installation. Installation of conduit shall be located and installed:
  - a. So as to not interfere with existing utilization equipment.
  - b. Not in front of intake/exhaust fans and louvers.
  - c. Not in front of access panels.

- d. Not in front of doors or windows.
  - e. In a location that does not allow maintenance and clearance to existing and proposed mechanical and electrical equipment
  - f. Not on floor or at a height above floor so as to be a tripping hazard,
  - g. Not installed in dedicated space that would limit an overhead cranes or similar lifting device's ability to remove intended equipment below. This includes but is not limited to access hatches, crane trucks, crane hoists, movement along crane rails, jib crane full swinging arc/areas, etc.
2. Contractor to notify Owner and Owners Designated Representative of all potential conduit installation conflicts with existing equipment, HVAC, plumbing, building or structural systems prior to field construction of conduit systems.
- H. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. Run conduits in crawl space under slab as if exposed.
- 1. Conduit Through Floor Slabs: Where conduits rise through floor slabs, curved portion of bends shall not be visible above finish slab.
  - 2. Conduit Support: Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration- resistant and shock-resistant. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended- ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Support exposed risers in wire shafts of multi-story buildings by U-clamp hangers at each floor level and at 10-foot maximum intervals. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. Support raceways within three (3) feet of each outlet box, junction box, cabinet or enclosure.
  - 3. Directional Changes in Conduit Runs: Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or

deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

4. Pull Wire: Install pull wires in empty conduits in which wire is to be installed by others. Pull wire shall be plastic having minimum 200-pound tensile strength. Leave minimum 12 inches of slack at each end of pull wire.
5. Telephone and Signal System Conduits: Install in accordance with specified requirements for conduit and with additional requirement that no length of run shall exceed 150 feet for trade sizes 2 inches and smaller and shall not contain more than two 90-degree bends or equivalent. Provide pull or junction boxes where necessary to comply with these requirements. Inside radii of bends in conduits 1-inch trade size and larger shall be minimum five times nominal diameter. Terminate conduit at bottom edge of backboard.
6. Conduit Installed in Concrete Floor Slabs: Locate so as not to adversely affect structural strength of slabs. Install conduit within middle 1/3 of concrete slab. Space conduits horizontally minimum three diameters, except at cabinet locations. Curved portions of bends shall not be visible above finish slab. Increase slab thickness as necessary to provide minimum 1-inch cover over conduit. Where embedded conduits cross expansion joints, provide suitable watertight expansion fittings and bonding jumpers. Conduit larger than 1-inch trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab. Where nonmetallic conduit is used, raceway must be converted to rigid steel or steel IMC before rising above floor, unless specifically indicated otherwise.
7. Locknuts and Bushings: Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.
8. Stub-ups: Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.
9. Flexible Connections: Provide flexible connections of short length, 6-foot maximum, for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Provide liquid-tight flexible conduit in wet locations. Provide separate ground conductor across flexible connections.

10. Arrange conduit to maintain headroom and present neat appearance.
11. Cut conduit square using saw or pipe cutter; deburr cut ends. For field cut threaded conduits, provide field applied anti-corrosion material to the threads in accordance with the manufacturer's instructions and per the NEC. Product shall be Thomas & Betts KOPR-Shield or approved equal.
12. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
13. Install no more than equivalent of three 90 degree bends between boxes.
14. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
15. Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.
16. Use Suitable caps to protect installed conduit against entrance of dirt and moisture.
17. Ground and bond conduit under as per NEC 250.

### 3.02 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in other sections.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation. Coordinate installation with representative of roofing material manufacturer to maintain any roof warranty.

END OF SECTION



## SECTION 26 05 35

### OUTLET, JUNCTION AND PULL BOXES

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Outlet, Junction and Pull Boxes, as shown on the Plans, as specified, and/or directed.
- B. Plans (drawings) are diagrammatic and show only approximate locations of equipment, fixtures, devices, etc. Plans may not show exact quantity and locations of Junction and Pull Boxes required for a complete installation. Exact locations and routing shall be determined in the field and shall suit the job conditions. Quantities and locations of Outlet, Junction, and Pull Boxes shall be provided to suit the installed arrangement and meet all NEC and local code requirements.

##### 1.02 REFERENCES

- A. NEMA
- B. UL. (Specifically UL 514A)
- C. NFPA 70

##### 1.03 SUBMITTALS

- A. Product Data: Catalog sheets, specifications and installation instructions.
  - 1. For fire rated construction, prove that materials and installation methods proposed for use are in accordance with the listing requirements of the classified construction.
- B. Shop Drawings: Plans, elevations, sections, and details for all custom enclosures and cabinets

##### 1.04 GENERAL REQUIREMENTS

- A. Section 26 05 01, "Electrical General Requirements", applies to this Section, with the additions and modifications specified herein.

## PART 2 - PRODUCTS

### 2.01 GALVANIZED STEEL OUTLET BOXES

- A. Standard galvanized steel boxes and device covers by Appleton Electric Co., Cooper/Crouse-Hinds, Hubbell, or approved equal.

### 2.02 GALVANIZED STEEL JUNCTION AND PULL BOXES

- A. Code gage, galvanized steel screw cover boxes by Hoffman Enclosures Inc., Hubbell Wiegmann, or approved equal

### 2.03 THREADED TYPE BOXES

- A. Outlet Boxes: For Dry, Damp Locations: Zinc electroplate malleable iron or cast iron alloy boxes by Appleton Electric Co., Cooper/Crouse-Hinds Co., or approved equal with zinc electroplate steel covers to suit application. For classified spaces, provide outlet boxes rated for Class I, Div. 1, group D hazardous areas as manufactured by Crouse-Hinds, Appleton or approved equal.
- B. For Wet Locations: Malleable iron or cast iron alloy boxes with hot dipped galvanized or other specified corrosion resistant finish as produced by Cooper/Crouse-Hinds (hot dipped galvanized or Corro-free epoxy powder coat), or OZ/Gedney Co. (hot dipped galvanized), with stainless steel cover screws, and malleable iron covers gasketed to suit application.
- C. Junction and Pull Boxes:
  - 1. For Dry, Damp Locations: Zinc electroplate cast iron boxes by Appleton Electric Co., Cooper/Crouse-Hinds, or approved equal with zinc electroplate steel or cast iron cover.
  - 2. For Wet Locations: Cast iron boxes by Cooper/Crouse-Hinds' (hot dipped galvanized or Corro-free epoxy powder coat), or OZ/Gedney Co. (hot dipped galvanized), or approved equal, with stainless steel cover screws and cast iron cover gasketed to suit application.
  - 3. For classified spaces, provide junction and pull boxes rated for Class I, Div. 1, group D hazardous areas as manufactured by Crouse-Hinds, Appleton or approved equal.
- D. Conduit Bodies, Threaded (Provided with a Volume Marking):
  - 1. For Dry, Damp Location: Zinc electroplate malleable iron or cast iron alloy bodies with zinc electroplate steel covers; Appleton Electric Co.'s Unilets, Cooper/Crouse-Hinds' Condulets, or approved equal.
  - 2. For Wet Locations: Malleable iron or cast iron alloy bodies with hot dipped galvanized or other specified corrosion resistant finish; Cooper/Crouse-Hinds' Condulets (hot dipped galvanized or Corro-free epoxy power coat), or OZ/Gedney Co.'s Conduit Bodies (hot dipped galvanized) or approved equal, with stainless steel cover screws and malleable iron covers gasketed to suit application.

3. For classified spaces, provide outlet conduit bodies rated for Class I, Div. 1, group D hazardous areas as manufactured by Crouse-Hinds, Appleton, or approved equal.

## 2.04 SPECIFIC PURPOSE OUTLET BOXES

- A. As fabricated by manufacturers for mounting their equipment.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Before proceeding with the installation of junction and pull boxes, check the locations with the Director's Representative and have same approved.

### 3.02 INSTALLATION

- A. Mounting Position of Wall Outlets For Wiring Devices: Unless otherwise indicated, install boxes so that the long axis of each wiring device will be vertical.
- B. Height of Wall Outlets: Unless otherwise indicated, locate outlet boxes with their center lines at the following elevations above finished floor:

Switches	4'-0"
Single & Duplex Receptacles	1'-6"
Special Purpose Receptacles	4'-0"
Telephone/Data Outlets	1'-6"
Telephone Outlets (Wall Phones)	4'-0"
Above-Counter Devices	8" Above Counter
Fire Alarm Manual Station	4'-0"
Fire Alarm Notification Device	7'-0"

- C. Wall Outlet Location: Locations shown on drawings are approximate only. Locate wall outlet boxes as near to position indicated as possible, but so as to avoid conflicts with other trades (architectural, mechanical, plumbing, structural, etc.).
- D. Where devices of different mounting heights are shown on drawings at same location, align outlet boxes along a common vertical line.
- E. Outlet boxes in a common wall serving separate rooms shall not be installed back-to-back.
- F. Outlet boxes shall be sized to accommodate the device that is to be installed.
- G. Provide box extensions and/or trim rings as required to accommodate construction of wall/ceiling in which boxes are recessed.

- H. Supplementary Junction and Pull Boxes: In addition to junction and pull boxes indicated on the drawings and required by NFPA 70, provide supplementary junction and pull boxes as follows:
  - 1. When required to facilitate installation of wiring.
  - 2. At every third 90 degree turn in conjunction with raceway sizes over 1 inch.
  - 3. At intervals not exceeding 100 feet in conjunction with raceway sizes over 1 inch.
- I. All Junction and Pull Boxes shall have a screw-on cover plate. Cover plate shall match box material and construction.
- J. Junction and Pull Boxes shall be installed in locations that are readily accessible, and shall not be blocked by equipment, piping, ducts, structural supports, etc.

### 3.03 OUTLET, JUNCTION, AND PULL BOX SCHEDULE

- A. Boxes For Concealed Conduit System:
  - 1. Non-Fire Rated Construction:
    - a. Depth: To suit job conditions and comply with NFPA 70 Article 370.
    - b. For Lighting Fixtures: Use galvanized steel outlet boxes designed for the purpose.
      - 1) For Fixtures Weighing 50 lbs. or Less: Box marked "FOR FIXTURE SUPPORT".
      - 2) For Fixtures More Than 50 lbs: Box listed and marked with the weight of the fixture to be supported (or support fixture independent of the box).
    - c. For Ceiling Suspended Fans:
      - 1) For Fans Weighing 35 lbs or Less: Marked "Acceptable for Fan Support."
      - 2) For Fans Weighing More Than 35 lbs, up to 70 lbs: Marked "Acceptable for Fan Support up to 70 lbs (or support fan independent of the box)."
    - d. For Junction and Pull Boxes: Use galvanized steel boxes with flush covers.
    - e. For Switches, Receptacles, Etc:
      - 1) Plaster or Cast-In-Place Concrete Walls: Use 4 inch or 4-11/16 inch galvanized steel boxes with device covers.
      - 2) Walls Other Than Plaster or Cast-In-Place Concrete: Use type of galvanized steel box which will allow wall plate to cover the opening made for the installation of the box.
- B. Boxes For Exposed Conduit System:
  - 1. Dry and Damp Locations: Use zinc electroplate or hot dipped galvanized threaded type malleable iron or cast iron alloy outlet, junction, and pull boxes or conduit bodies provided with a volume marking in conjunction

with ferrous raceways unless otherwise specified or indicated on the drawings.

- a. Galvanized steel boxes may be used in conjunction with conduit sizes over 1 inch in non-hazardous dry and damp locations.
  - b. Galvanized steel boxes may be used in conjunction with electrical metallic tubing where it is allowed (specified) to be installed exposed as branch circuit conduits at elevations over 10'-0" above finished floor.
2. Wet Locations: Use threaded type malleable iron or cast iron alloy outlet junction, and pull boxes or conduit bodies (provided with a volume marking) with hot dipped galvanized or other specified corrosion resistant coating in conjunction with ferrous raceways unless otherwise specified or indicated on the drawings.
- a. Use corrosion resistant boxes in conjunction with plastic coated rigid ferrous metal conduit.
- C. Specific Purpose Outlet Boxes: Use to mount equipment when available and suitable for job conditions. Unless otherwise specified, use threaded type boxes with finish as specified for exposed conduit system, steel (painted) for surface metal raceway system and galvanized steel for recessed installations.

### 3.04 LABELING

- A. Identify junction and pull boxes for system served (i.e. power, lighting, fire alarm, telephone, data, public address, nurse call, etc.), using stencil lettering on box cover.
- B. Identify panelboard and circuit number of all conductors contained within junction and pull boxes, using stencil lettering on box cover.
- C. Identify junction and pull boxes for systems over 600V as follows: "DANGER HIGH VOLTAGE – KEEP OUT." Label shall be white stencil lettering, minimum 1" text height, on box cover.

END OF SECTION

## SECTION 26 27 26

### WIRING DEVICES

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Wiring Devices as shown on the Plans, as specified, and/or directed.

##### 1.02 REFERENCES

- A. NEMA
- B. UL
- C. NFPA 70

##### 1.03 SUBMITTALS

- A. Product Data: Catalog sheets, specifications and installation instructions.

##### 1.04 RELATED SECTIONS

- A. Section 26 05 01, "Electrical General Requirements", applies to this Section, with the additions and modifications specified herein.

#### PART 2 - PRODUCTS

##### 2.01 SWITCHES

- A. Local Switches, Single Pole: 20A, 120/277 V ac; Bryant's 4901, Crouse-Hinds/AH's 1991, Hubbell's 1121/1221, Leviton's 1121/1221, Pass & Seymour's 20AC1.
- B. Local Switches, Double Pole: 20A, 120/277 V ac; Bryant's 4902, Crouse-Hinds/AH's 1992, Hubbell's 1222/1122, Leviton's 1222/1122, Pass & Seymour's 20AC2.
- C. Local Switches, Three-Way: 20A, 120/277 V ac; Bryant's 4903, Crouse-Hinds/AH's 1993, Hubbell's 1223/1123, Leviton's 1223-2/1123-2, Pass & Seymour's 20AC3.
- D. Local Switches, Four-Way: 20A, 120/277 V ac; Bryant's 4904, Crouse-Hinds/AH's 1994, Hubbell's 1224/1124, Leviton's 1224-2/1124-2, Pass & Seymour's 20AC4.

- E. Local Switches, Dimming: 20A, 120/277 V ac; Eaton's WBSD-010SLD, Leviton's 66EV-10W, Pass & Seymour's WS4FBL3PW.

## 2.02 RECEPTACLES

- A. Federal Spec./NEMA Grade Receptacles:
  - 1. Single receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Bryant's 5361, Crouse-Hinds/AH's 5361, Hubbell's 5361, Leviton's 5361, or Pass & Seymour's 5361.
  - 2. Duplex receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Bryant's 5362, Crouse-Hinds/AH's 5739-S, Hubbell's 5362, Leviton's 5362, Pass & Seymour's 5362, or Daniel Woodhead's 5362 DW.
- B. Ground Fault Interrupter Receptacles: Duplex receptacle rated 20A (NEMA 5-20R), circuit ampacity 20A; Bryant's GFR53FT, Crouse-Hind/AH's GF5342, Hubbell's GF 5352, Leviton's 6899, Pass & Seymour's 2091S,

## 2.03 WALL PLATES

- A. Stainless Steel Wall Plates: Type 302 stainless steel with satin finish. All areas except finished spaces or wet locations.
- B. Weatherproof/Wet Location Covers: UL 514D type "extra duty". Thomas & Betts Red Dot Code Keeper type 2CKU or equal.
- C. Finished areas: Polycarbonate. Color to match device color.

## 2.04 NAMEPLATES

- A. Phenolic Type: Standard phenolic nameplates with 3/16 inch minimum size lettering engraved thereon.
- B. Embossed Aluminum: Standard stamped or embossed aluminum tags, 3/16 inch minimum size lettering, as produced by Seton Name Plate Corp. or Tech Products Inc.

# PART 3 - EXECUTION

## 3.01 INSTALLATION

- A. Install wiring devices in outlet boxes.
- B. Local Switches:
  - 1. Install local switches rated 20A, 120/277 V ac for switches unless otherwise shown on the drawings or specified.
  - 2. Where more than one switch occurs at same location in a 120 volt system, arrange switches in gangs and cover with one face plate.

3. Install single and double pole switches so that switch handle is up when switch is in the “On” position.
- C. Receptacles:
1. Install Specification Grade receptacles, NEMA 5-20R, 20A, 125 V, 2P, 3W, for duplex receptacles and single receptacles unless otherwise shown on the drawings or specified.
  2. Install receptacles with ground pole in the down position.
- D. Wall Plates:
1. Install wall plates on all wiring devices in dry locations, with finish to match hardware in each area.
- E. Weatherproof In-use Covers: Install weatherproof covers on wiring devices in damp and wet locations.
- F. Nameplates: Provide phenolic or embossed aluminum nameplate for each special purpose receptacle indicating phase, ampere and voltage rating of the circuit. Attach nameplate with rivets or tamperproof fasteners to wall plate or to wall above receptacle. Wall plates may be engraved with required data in lieu of separate nameplates.
- G. Labels: Provide electronically-generated, self-sticking label at each wiring device. Label shall indicate panel designation and circuit number associated with respective device. Label shall be attached to outside of wall plate.
- H. Where Contract Drawings call out a classified area all equipment/devices and wiring methods to be suitable for this area per NEC. Refer to Contract Drawings for classified area locations.

END OF SECTION



## SECTION 26 28 14

### CIRCUIT BREAKERS FOR EXISTING PANELBOARDS

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Circuit Breakers For Existing Panelboards, as shown on the Plans, as specified and/or directed.

##### 1.02 SUBMITTALS

- A. Not Required.

#### PART 2 - PRODUCTS

##### 2.01 CIRCUIT BREAKERS

- A. Similar to existing circuit breakers.
- B. Compatible with existing panelboard.
- C. Number of poles and ampere trip rating as indicated on Contract Drawings.
- D. Complete with accessories required for installation.
- E. All heating and air conditioning circuit breakers shall be "HACR" rated.

#### PART 3 - EXECUTION

##### 3.01 INSTALLATION

- A. Install new circuit breakers in existing panelboards where indicated.
- B. Add new circuits equally across phases to prevent overloading any phase in the panelboard. After new and existing circuits are energized, take current reading on panelboard feeder during a heavy usage time period. If phases are substantially unbalanced, rearrange both new and existing circuits in panelboard to equally distribute load between all phases, and provide new typewritten directory indicating equipment controlled by each circuit breaker.

END OF SECTION

## SECTION 26 51 01

### INTERIOR LIGHTING

#### PART 1 - GENERAL

##### 1.01 SCOPE

- A. The work under this Interior Lighting includes interior luminaires and accessories, exit signs, and building-mounted exterior lighting.

##### 1.02 RELATED WORK

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

##### 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 SUBMITTALS

- A. Include outline drawings, lamp and ballast data, support points, weights, accessory information and performance data for each luminaire type.
- B. For each luminaire type, submit luminaire information including catalog cuts with highlighted catalog numbers and required accessories:
  - 1. Luminaire:
    - a. Manufacturer and catalog number,
    - b. Type (identification) as indicated on the plans and schedule,
    - c. Delivered lumens,
    - d. Input watts,
    - e. Efficacy,
    - f. Color rendering index.

2. Driver:
  - a. Manufacturer and catalog number,
  - b. Type (Non-Dimming, Step-dimming, Continuous dimming, etc.),
  - c. Power Factor, Crest Factor, THD, etc.

#### 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 EXTRA MATERIALS

- 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, provide one (1) of each of these types of luminaires.
- C. Provide one (1) LED driver or ballast of each type.

#### 1.07 DEFINITIONS

- A. Driver: The power supply used to power LED luminaires, modules, or arrays.
- B. L70, L<sub>70</sub>, or L<sub>70</sub>%; 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. LEDs: 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.

### 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 listed by a NRTL (Nationally Recognized Testing Laboratory: e.g., UL, ETL, etc.).

- C. Provide luminaires with quick-connect disconnecting means, similar to Thomas & Betts Sta-Kon.
- D. Fluorescent T8 lamps and ballasts shall be listed on CEE high-performance qualifying product list and approved by Focus-On-Energy.

## 2.02 GENERAL USE LAMPS

- A. General Use Incandescent Lamps and Incandescent Reflector Lamps are prohibited. Use LED retrofit lamps or LED luminaires in lieu of incandescent or halogen luminaires. LED retrofit lamps shall be:
  - 1. Rated for the voltage of the incandescent lamp/luminaire they are replacing.
  - 2. Dimmable where required as indicated on the Plans.
  - 3. Rated for the luminaire in which they are being installed. Verify whether the luminaire is enclosed and whether the LED retrofit lamp is rated for enclosed luminaires and the temperatures that will be encountered.
  - 4. LED lamps/luminaires shall provide delivered footcandles equal to or greater than the footcandles provided by an equivalent incandescent lamp/luminaire.
  - 5. LED retrofit lamps shall have an average rated life of 25,000 hours, minimum.
  - 6. Lamp color temperature shall be nearly equal to the incandescent lamp it is replacing.
- B. All lamps shall be new.

## 2.03 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. The color temperature of exterior LED luminaires should not exceed 4100K (nominal).

- 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. Exterior luminaires shall use a maximum 5-step MacAdam Ellipse binning process.
- D. Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.
- E. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- F. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- G. 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.
- H. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
- I. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- J. Luminaire and driver 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 -40°F to 104°F (-40°C to 40°C).
- M. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- N. Luminaire shall have a maximum Total Harmonic Distortion (THD) of  $\leq 20\%$  at full input power and across specified voltage range.
- O. 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.
- P. All luminaires shall be provided with knockouts for conduit connections.
- Q. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).

- R. Provide all of the following data on submittals:
  - 1. Delivered lumens
  - 2. Input watts
  - 3. Efficacy
  - 4. Color rendering index.
- S. LED Luminaires used for Emergency Egress Lighting: The failure of one LED shall not affect the operation of the remaining LEDs.
- T. Emergency LED Luminaire Compatibility with Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer that the luminaire will function with a square-wave inverter.

## 2.04 LED DRIVERS

- A. General Drivers:
  - 1. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated on the luminaire schedule on the drawings.
  - 2. Minimum Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
  - 3. Driver shall have a rated life of 50,000 hours, minimum.
  - 4. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
  - 5. 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.
  - 6. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
  - 7. Driver shall have a maximum Total Harmonic Distortion (THD) of  $\leq 20\%$  at full input power and across specified voltage range.
  - 8. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
  - 9. 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.
  - 10. Provide all of the following data on submittals:
    - a. Input watts
    - b. Power Factor (pf)
    - c. Crest Factor (cf) at full input power
    - d. Total Harmonic Distortion (THD).
- B. Dimming Drivers:
  - 1. LED driver shall be compatible with dimming controls where dimming is indicated on the Plans. Dimmable drivers shall use Dimming Constant Current (DCC), Constant Voltage, or Pulse Width Modulation (PWM) operation.

2. Step-Dimming Drivers: Easily switched from 0% to 50% to 100% output power. Both switch-leg inputs shall control 50% of the luminaire's light output equally.
3. Continuous Dimming Drivers: LED luminaires shall dim to (10%, 1%, or 0.1%) as specified in the Luminaire Schedule on the Plans without visible flicker or "popcorn effect". "Popcorn effect" is defined as the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level when power is returned to the luminaire. Continuous Dimming Drivers shall use 0-10V control.

## 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 wiring method to the chain.
- D. Support luminaires larger than 2 x 4 foot (600 x 1200 mm) size independent of ceiling framing.
- E. Provide independent support for all luminaires over 50 lbs.
- F. Locate ceiling luminaires as indicated on reflected ceiling plan.
- G. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- H. 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.

- I. Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips.
- J. Install recessed luminaires to permit removal from below.
- K. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- L. Install code required hardware to secure recessed grid-supported luminaires in place.
- M. 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.
- N. Install accessories furnished with each luminaire.
- O. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- P. Bond luminaires and metal accessories to branch circuit equipment grounding conductor.
- Q. Install specified lamps in each luminaire and exit sign.
- R. HID High-Bay or Low-Bay Luminaires: Use power hook hangers rated 500 pounds (225 kg) minimum and provide safety chain between ballast and structure. Also provide safety chain between reflector and ballast.
- S. Dimmed luminaire circuits shall have separate neutrals.
- T. Dimmed LED luminaires shall have a positive OFF, which requires turning off the circuit to the luminaire so that the luminaires don't "glow" at the lowest dimmed setting. This shall be accomplished using a switch, relay, or some other means acceptable to DFD.
- U. All lamps shall be delivered to the job in sealed cartons and protected from dirt and dust during storage on the project. Lamps shall be taken directly from the cartons and installed in the luminaire with special care so that they do not become dusty and are not soiled in the operation.
- V. Lamps installed in luminaires using dimming ballasts shall be burned in at 100% rated output by the contractor for a minimum of 100 hours as recommended by the ballast manufacturer.
- W. All new lamps shall be operational at the Substantial Completion of the project.



### 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. Interface with air handling accessories furnished and installed under Division 23.
- B. Provide controls as indicated on the plans. Refer to Section 26 27 26, "Wiring Devices". Controls shall be compatible with the luminaires/ballasts/drivers being installed.

### 3.04 ZERO-TO-10V DIMMING CONTROL WIRING INSTALLATION

- A. Zero-to-10V dimming control conductors are classified by the NEC as Class 2 conductors and shall be kept separate from line-voltage conductors per NEC 725.136(A). Matching the insulation rating of Conductors of Different Systems does not apply to Class 2 conductors per NEC 300.3(C)(1), Informational Note No.1.
- B. Wall box dimmers will typically have two conduits: One conduit for line-voltage power, and one conduit or conduit stub for the 0-10V control wiring.
- C. At each luminaire, separate openings (either manufactured knock-outs or punched openings) shall be used for the line-voltage power and the 0-10V wiring. The EC shall use a cable connector at the opening for the 0-10V wiring. Zero-to-10V conductors entering and within a luminaire enclosure shall maintain a minimum separation of 6 mm (0.25 in.) per NEC 725.136(D).
- D. Exposed 0-10V cables shall be installed in separate conduits from line-voltage conductors.
- E. The 0-10V cables may be routed in free air where concealed above accessible ceilings. Cables routed in free air shall observe the following installation requirements:
  - 1. The 0-10V cables may be tie-wrapped to the outside of the luminaire power raceway where allowed by NEC 300.11(B)(2). Tie-wraps shall be UL listed for UV resistance. Care should be taken in the use of cable ties to secure and anchor the cabling. Ties shall not be over tightened as to compress the cable jacket. No sharp burrs shall remain where excess length of the cable tie has been cut.
  - 2. Cabling shall be neatly run at right angles and be kept clear of other trades work.

3. Cabling shall be secured within twelve (12) inches of direction change or termination.
4. Cabling shall be supported at a maximum of 5-foot intervals utilizing “J-Hook” or “Bridle Ring” supports anchored to ceiling concrete, piping supports or structural steel beams. If cable sag at mid-span exceeds 12-inches, another support shall be provided. Cable supports shall be installed to maintain cable bend to larger than the minimum bend radius.
5. Cabling shall not be attached to or supported by existing cabling, plumbing or steam piping, ductwork, suspended ceiling supports or electrical or communications conduit. Do not place cable directly on the ceiling grid or attach cable in any manner to the ceiling grid wires.
6. All cables shall be free of tension at both ends. Nylon strain relief connectors shall be provided at each device and junction box where cables enter. In cases where the cable must bear some stress, Kellum type grips may be used to spread the strain over a longer length of cable.
7. Cable manufacturer’s minimum bend radius shall be observed in all instances.
8. Use suitable cable fittings and connectors.

### 3.05 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

### 3.06 LUMINAIRE CONNECTIONS

- A. Metal-Clad (MC) Cable Whips
  1. Metal-Clad (MC) type cable that combines power and Class 2 circuits into a single cable may be used for luminaire whips where 0-10V dimming control wiring is required. Whips may not exceed six (6) feet in length. Examples of such products are Encore Wire® MC-LED™ or Southwire® MC-PCS Duo™. Manufacturer's names and catalog numbers are used for quality and performance only. MC Cables manufactured by others shall be equally acceptable provided they meet or exceed in performance and quality as specified.
- B. Recessed, including Master-Satellite connections:
  1. 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). Metal Clad (MC) cable that combines power and Class 2 circuits (for 0-10V dimming control) into a single cable may be used as a whip for luminaires that are dimmed.
  2. Cable/Conduit whips shall be 3/8" (10 mm) minimum diameter, six feet (1.8 m) maximum length.
  3. Flexible whips or pre-wired systems between master and satellite luminaires may be supported by the ceiling grid wires.

4. 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 units.
- C. Chain or Cable Hung (unfinished spaces):
1. Use manufacturer's SO cord or a luminaire fixture whip from a J-box. Luminaire fixture whips shall be aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC). Metal Clad (MC) cable that combines power and Class 2 circuits (for 0-10V dimming control) into a single cable may be used as a whip for luminaires that are dimmed.
  2. Conduit whips shall be 3/8" (10 mm) minimum diameter. Conduit whip or SO cord shall be cut to length (six feet (1.8 m) maximum) and shall allow movement of the chain/cable/luminaire, but shall not be long enough to "loop" and shall present a neat and workmanlike appearance.
  3. Luminaire field wired flexible cord installations shall be connected per NEC 410.62.
  4. 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 units.
  5. Conduit whip slack shall be tie-wrapped to the chain supports. Tie-wraps shall be UL listed for UV resistance.
- D. Cable Hung (finished spaces):
1. Use manufacturer's SO cord from luminaire to a J-box.
  2. SO cord shall be cut to length (six feet (1.8 m) maximum) and shall allow movement of the cable/luminaire, but shall not be long enough to "loop" and shall present a neat and workmanlike appearance.
  3. SO cord slack may be tie-wrapped to the cable supports. Tie-wraps shall be UL listed for UV resistance.
  4. Luminaire field wired flexible cord installations shall be connected per NEC 410.62.
- E. Surface Mounted (unfinished spaces): Provide direct conduit and box connection.
- F. Surface Mounted (finished spaces): Provide direct conduit and box connection. Use surface metal raceway where indicated on drawings. Conceal box and conduit where appropriate. Flexible metal conduit shall not be used where the conduit is exposed.

END OF SECTION

## SECTION 28 46 21

### ADDRESSABLE FIRE ALARM AND DETECTION SYSTEM

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. Under this Section, the Contractor shall furnish all labor, materials, equipment and services to perform all operations required for the complete installation and related work as shown on drawings and specified herein for a fully operational Addressable Fire Alarm and Detection System.

##### 1.02 REFERENCES

- A. Comply with the latest edition of the following applicable publications, codes, standards, and listings/approvals, including recommendations and appendices:
  - 1. National Fire Protection Association (NFPA) Publications:
    - a. NFPA 70 National Electrical Code
    - b. NFPA 72 National Fire Alarm Code
    - c. NFPA 101 Life Safety Code
  - 2. Underwriters Laboratories Inc. (UL) Fire Protection Equipment Directory.
    - a. 864 9<sup>th</sup> Edition
  - 3. Requirements of County Code Enforcement Officer.
  - 4. Building Code of New York State (BCNYS).

##### 1.03 QUALIFICATIONS OF INSTALLER

- A. Utilize system manufacturer authorized and factory trained/certified technicians. Technicians shall be certified NICET Level III Fire Alarm Layout Technicians to supervise layout and installation. The technician(s) shall be on site for supervision of the installation and testing of the system. Meet all applicable licensing and certification requirements.

##### 1.04 GENERAL REQUIREMENTS

- A. Section 26 05 01, "Electrical General Requirements", applies to this Section, with the additions and modifications specified herein.

##### 1.05 EQUIPMENT/COMPONENTS

- A. Shall be UL Listed and labeled individually and as a system for intended use. Utilize products of a single manufacturer. Certify compatibility and listing requirements for smoke detectors and fire alarm control panel.

## 1.06 SYSTEM DESCRIPTION

- A. General: Provide a complete, non-coded, addressable, microprocessor-based fire alarm system with initiating devices, notification appliances, monitoring and control devices as indicated on the Contract Drawings and as specified herein.
  - 1. The proposed fire alarm system includes but is not limited to:
    - a. New alarm detection devices.
    - b. New initiation devices.
    - c. New annunciation (audible and visual) devices.
    - d. New door hold circuit.
    - e. New fire damper control circuit.
    - f. New fan shutdown circuit.
    - g. New duct detectors with remote test switches.
    - h. New remote annunciator panel.
    - i. New zone addressable devices as required to connect to existing detection and initiation devices.
    - j. New zone addressable devices as required to connect to existing notification devices.
    - k. Provisions as required to connect to existing annunciator panel.
  - 2. The existing detection, initiation and annunciation device circuits shall be re-used and connected to the new fire alarm system. Provide all necessary wiring devices, hardware, and software programming as required to integrate the new fire alarm system with the existing fire alarm system components as specified herein.
- B. System shall incorporate microprocessor based and field programmable addressable fire alarm control panel units, addressable intelligent smoke detectors, addressable manual pull stations, addressable monitor modules and control modules.
- C. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of 100% on-site programming to accommodate system expansion and facilitate changes in operation. All programming shall be capable of being accomplished via the front panel and via a laptop computer. All software operations shall be stored in a non-volatile programmable memory within the FACP. Loss of primary and secondary power shall not erase the instructions stored in memory.
- D. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. Separate alarm, supervisory and trouble logs shall be provided.
- E. Each Signaling Line Circuit (SLC) and Notification Appliance Circuit (NAC): Limited to only 80 percent of its total capacity during initial installation. Provide capacity calculations.

- F. Basic Performance:
1. Signaling Line Circuits (SLC) Serving Addressable Devices: Wired Style 6 (Class A).
  2. Initiation Device Circuits (IDC) Serving Non-addressable Devices Connected to Addressable Monitor Modules: Wired Class A (NFPA Style D).
  3. Notification Appliance Circuits (NAC) Serving Strobes and Horns: Wired Class A (NFPA Style Z).
  4. On Style 6 or 7 (Class A) Configurations: Single ground fault or open circuit on Signaling Line Circuit shall not cause system malfunction, loss of operating power, or ability to report alarm.
  5. Alarm Signals Arriving at Control Panel: Not lost following primary power failure until alarm signal is processed and recorded.
  6. Network Node Communications:
- G. System shall have the capability of networking with other Control Panels on single pair of copper wires or fiber optic cables.
- H. Signaling Line Circuits (SLC):
1. Reside in remote panels with associated audio zones.
  2. SLC modules shall operate in peer-to-peer fashion with all SLC modules in the Control Panel.
  3. On loss of an SLC module, each remaining panel shall continue to communicate with remainder of system, including all SLC and control functions.
    - a. NAC Circuits: Arranged such that there is a minimum of one audible device per fire alarm zone.
    - b. Notification Appliance Circuits (NAC), and Control Equipment: Arranged such that loss of any one NAC circuit will not cause loss of any other NAC circuit in system.
    - c. NAC Circuits:
  4. Electrically supervised for open and short circuit conditions.
  5. If short circuit exists on NAC circuit, it shall not be possible to activate that circuit.
- I. Basic System Functional Operation: When fire alarm condition is detected and reported by one of the system alarm initiating devices, the following functions shall immediately occur:
1. System Alarm LEDs: Flash.
  2. Local Piezo-Electric Signal in Control Panel: Sound at a pulse rate.
  3. 80-Character LCD Display: Indicate all information associated with fire alarm condition, including type of alarm point and its location within protected premises.
  4. Historical Log: Record information associated with fire alarm control panel condition, along with time and date of occurrence.

5. System output programs assigned via control-by-event equations to be activated by particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
  6. Strobes flash synchronized continuously.
  7. Audible devices sound continuous Temporal pattern until system is reset.
- J. Wiring/Signal Transmission:
1. Transmission shall be addressable signal transmission, dedicated to fire alarm service only.
  2. System connections for initiating (signaling) circuits and notification appliance circuits shall be Class A.
  3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone and alphanumeric annunciation.
- K. Remote Access:
1. FACP shall have the capability to provide remote access through a dial-up service modem using the public switched telephone system of a private switched telephone system.
  2. A personal computer or technician's laptop, configured with terminal emulation software shall have the ability to access the FACP for diagnostics, maintenance reporting and information gathering.
- L. Required Functions: The following are required system functions and operating features:
1. Priority of Signals: Alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Supervisory and Trouble events have second-, and third-level priority respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.
  2. Noninterfering: The activation of an addressable device does not prevent the receipt of signals from subsequent activations.
  3. Transmission to Remote Central Station: Automatically route alarm supervisory, and trouble signals to a remote central station service transmitter provided under another contract.
  4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and any required remote annunciators, indicating the location and type of device.
  5. General Alarm: A system general alarm shall include:
    - a. Indication of alarm condition at the FACP and any required remote annunciator(s).
    - b. Identification of the device that is the source of the alarm at the FACP and any required remote annunciator(s).

- c. Operation of audible and visible notification appliances throughout the building until silenced at FACP. Audible alarm notification shall operate temporal code.
  - d. Closing doors normally held open by magnetic door holders.
  - e. Unlocking designated doors.
  - f. Shutting down supply and return fans serving zone where alarm is initiated.
  - g. Closing smoke dampers on system serving zone where alarm is initiated.
  - h. Initiation of smoke control sequence.
  - i. Notifying the local fire department.
  - j. Communicate with building DDC system to shut down all air handler fans.
6. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible and visible alarm signals shall cease operation.
7. System Reset:
- a. The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-arming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED".
  - b. Should an alarm condition continue, the system will remain in an alarmed state.
8. Drill: A manual evacuation (drill) switch shall be provided to initiate an alarm on the FACP.
9. Manual Control: Manual controls shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble. The "off normal" status shall be clearly identified in plain-language on the FACP alphanumeric display.
- a. Manual Bypass Control: The ability to perform a manual bypass of selected automatic functions shall be provided.
  - b. Circuit Enable/Disable Control: the system shall have provisions for disabling and enabling each circuit individually for maintenance or testing purposes.
10. Walktest: The system shall have a one person test feature. Enabling the one person test feature at the FACP shall activate the "One person Testing" mode of the system as follows:
- a. The city circuit connection and suppression release circuits shall be bypassed for the testing group.
  - b. Control relay functions associated to the testing group shall be bypassed.
  - c. The FACP shall indicate a trouble condition.



- d. The alarm activation of any initiation device in the testing group shall cause the audible notification appliances to sound a code to identify the device.
- e. The control panel shall automatically reset itself after signaling is complete.
- f. Any momentary opening of an initiating or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.

## 1.07 SUBMITTALS

- A. Submittals shall comply with the requirements of BCNYS 907.1.1 “Construction Documents”. Specifically, submittals shall include the following:
  - 1. A floor plan
  - 2. Locations of alarm – initiating and notification appliances
  - 3. Alarm control and trouble signaling equipment
  - 4. Annunciation
  - 5. Power connection
  - 6. Battery calculations
  - 7. Conductor type and sizes
  - 8. Voltage drop calculations
  - 9. Manufacturers, model numbers and listing information for equipment, devices and material
  - 10. Details of ceiling height and construction
  - 11. The interface of fire safety control functions
  - 12. SLC and NAC circuit calculations
  - 13. System riser diagram
- B. NYS Department of State License to install fire alarm and security systems and NICET certification.
- C. Product Data: Manufacturer’s catalog cuts with models, options, and specifications, quantitative equipment list; installation instructions for components.
- D. Electrical Load and Power Supply Calculations: Calculations using actual amperage loads for each device during standby and alarm conditions.
- E. Drawings: Wiring and riser diagrams: symbol legends, title block and drawing scale.
  - 1. Floor Plans: Initiating device and notification appliance locations with addresses indicated, panels, terminal cabinets, risers, electrical power connections, individual circuits and raceway routing, zone designations; number size, type raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway.

2. Typical wiring diagrams: for each device showing termination identifications, size and type conductors.
3. Detailed wiring diagrams: for control panels, modules, power supplies, electrical power connections, auxiliary relays and annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams to actual size or larger showing special relationships between components, enclosures, and equipment configuration.
4. Riser diagram: Number, size and type of riser raceways and conductors in each riser raceway and number of each device. Include point to point wiring, address and exact label description of each addressable device.
5. Include information in creating who will certify the system and who will perform the guaranteed period services.
6. System input/output sequence of operation.

F. Record Documents:

1. In each operation and maintenance manual: product data, as built drawings, test reports NY State Board of Fire Underwriters Final Electrical Inspection Certificate, Fire Alarm Certificate of Completion per NFPA 72. Bind in sets.
2. Include information for testing, repair, trouble-shooting, assembly, disassembly, and recommended maintenance intervals.
3. Provide a replacement parts list with current contract prices. Include a list of recommended tools, and instruments for testing and maintenance purposes.
4. Furnish manual in 3-ring, loose-leaf binder or manufacturer's standard binder with space for folded drawings.
5. Contractor shall provide two (2) video CD/tapes of basic operation and procedures of the system.

G. Certifications:

1. Submit certification from the fire alarm equipment manufacturer stating that the proposed supervisor of installation and the proposed performer of guaranteed period services is an authorized representative of the fire alarm equipment manufacture. Include name and address in the certification.
2. Submit certification from fire alarm equipment manufacturer and detector manufacturer that the initiating devices furnished are listed by UL as being compatible with the control equipment.
3. Submit certification from the fire alarm equipment manufacturer that wiring and connection diagrams meet this Specification, UL and NFPA requirements.
4. Submit installer NICET certification.
5. Submit NYS fire alarm license.

## 1.08 ACCEPTANCE TEST AND DOCUMENTATION

- A. The fire alarm system shall be fully tested per NFPA 72. All testing shall be done in the presence of representatives from the Owner. The Contractor shall provide the Project Engineer and Owner with 72-hour workday notice indicating the date and time it is scheduled. Failure to comply will invalidate tests, and must be repeated at Contractor's expense. Certification documentation per NFPA 72 format shall be submitted for review and approval by the Engineer.

## PART 2 - PRODUCTS

### 2.01 REMOTE LCD ANNUNCIATOR

- A. Provide remote LCD annunciator(s) as required with the same "look and feel" as the FACP operator interface. The remote LCD annunciator shall use the same primary acknowledge, silence, and reset keys, status LEDs and LCD display as the FACP.
- B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with three (3) programmable LEDs (two selectable as red or yellow; one selectable as green or yellow).
- C. Under normal conditions the LD shall display a "SYSTEM IS NORMAL" message and the current time and date.
- D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
- E. The LCD shall display the following information relative to the abnormal condition of a point in the system:
  - 1. 40 character custom location label.
  - 2. Type of device (e.g., smoke, pull station, water flow).
  - 3. Point status (e.g., alarm, trouble).
- F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, silence and reset operation shall be the same as FACP.

### 2.02 GRAPHIC ANNUNCIATOR

- A. Provide individual LED indicators for each alarm and supervisory zone and a LED to indicate system trouble. Additional LEDs indicate normal power and emergency power modes for the system. A toggle or push-button switch tests the LEDs mounted on the unit. The test switch does not require key operation.

- B. The annunciator shall indicate each alarm initiating device zone graphically.
- C. Enclosure: Finish to match fire alarm control panels. The locking cover/display assembly is hinged on the left. Key and lock shall be common to all secured fire alarm system enclosures.

## 2.03 EMERGENCY POWER SUPPLY

- A. General: Components include battery, charger, and an automatic transfer switch.
- B. Battery: Sealed lead-acid type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 48 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all notification appliances in alarm or supervisory mode for a period of 10 minutes.

## 2.04 ADDRESSABLE MANUAL PULL STATIONS

- A. Description: Addressable single- or double-action type, red LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.

## 2.05 SMOKE SENSORS

- A. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems". Include the following features:
  - 1. Factory Nameplate: Serial number and type identification.
  - 2. Operating Voltage: 24 VDC, nominal.
  - 3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
  - 4. Plug-In Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit.
  - 5. Quick Connect Arrangement: Photoelectric sensor and electronics in a single piece construction which shall twist-lock onto a mounting base that attaches to a standard electrical box.
  - 6. Each sensor base shall contain an LED that will flash each time it is scanned by the control unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.
  - 7. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.

8. Each sensor shall be scanned by the control unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a “wrong device”, the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate -of-rise for the heat sensor, but shall indicate a “Wrong Device” trouble condition.
  9. The sensor’s electronics shall be immune from false alarms caused by EMI and RFI.
  10. Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Sensor address shall be located in base to eliminate false addressing when replacing sensors.
  11. Removal of the sensor head for cleaning shall not require the setting of addresses.
- B. Type: Smoke sensors shall be of the photoelectric or combination photoelectric/heat type. Where acceptable per manufacturer specifications, ionization type sensors may be used.
- C. Bases: Relay output, sounder and isolator bases shall be supported alternatives to the standard base.
- D. Duct Smoke Sensor: Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor includes relay as required for fan shutdown.
1. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.
  2. The duct housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single “Form C” contact rated at 7A@ 28VDC or 10A@ 120 VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.
  3. Duct housing shall provide a relay control trouble indicator Yellow LED.
  4. Compact duct housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
  5. Duct housing shall provide two (2) test ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
  6. Duct housing shall provide a magnetic test area and Red sensor status LED.
  7. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
  8. Each duct sensor shall have a remote test station with an alarm LED and test switch.

9. A NEMA 4X weatherproof duct housing enclosure shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL listed to Standard 268A.
- E. Analog Smoke Sensors:
1. Monitoring: FACP shall individually monitor sensors for calibration, sensitivity, and alarm conditions, and shall individually adjust for sensitivity. The FACP shall determine the condition of each sensor by comparing the sensor value to the stored values.
  2. Environmental Compensation: The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.
  3. Programmable Sensitivity: Photoelectric smoke sensors shall have 8 sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACP.
  4. Sensitivity Testing Reports: The FACP shall provide sensor reports that meet NFPA 72 calibrated test method requirements. The reports shall be viewed on a maintenance terminal CRT display or printed for annual recording and logging of the calibration maintenance schedule.
  5. Peak Value Logging: The FACP shall log the peak value of smoke obscuration or degree of temperature for each individual sensor to allow system calibration for maximum response time performance without nuisance alarms based on "actual ambient conditions".
  6. The FACP shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to indicate that a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate that a sensor is close to a trouble reporting condition and will be indicated on the FACP as "ALMOST DIRTY". This condition provides a means to alert maintenance staff of a dirty sensor without creating a trouble in the system. If this indicator is ignored, a second level "DIRTY SENSOR" condition shall be indicated at the FACP. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended, and its average value increases to a third predetermined value, and "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control panel.
  7. The FACP shall continuously perform an automatic self-test on each sensor which will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.

## 2.06 HEAT SENSORS

- A. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.
- B. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.
- C. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 135-deg F or 155- deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15- deg F or 20-deg F per minute.
- D. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

## 2.07 ADDRESSABLE CIRCUIT INTERFACE MODULES

- A. Addressable Circuit Interface modules: Arrange to monitor one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of water flow, valve tamper, non-addressable devices, and for control of evacuation indicating appliances and AHU systems.
- B. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line or a separate two wire pair running from an appropriate power supply as required.
- C. There shall be the following types of modules:
  - 1. Type 1: Monitor Circuit Interface Module:
    - a. For conventional 2-wire smoke detector and/or contact device monitoring with Class B or class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACP.
    - b. For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide Detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.
  - 2. Type 2: Line Powered Monitor Circuit Interface Module:
    - a. This type of module is an individually addressable module that has both its power and its communications supplied by the two wire multiplexing signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open

- dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACP.
- b. This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.
- 3. Type 3: Line Powered Control Circuit Interface Module:
    - a. This module shall provide control and status tracking of a Form “C” contact. The two-wire signaling line circuit shall supply power and communications to the module.
- D. All circuit interface modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

## 2.08 ADDRESSABLE ALARM NOTIFICATION APPLIANCES

- A. Addressable Notification Appliances: The Contractor shall furnish and install addressable notification appliances and accessories to operate on compatible signaling line circuits (SLC).
- 1. Addressable notification appliance operation shall provide power, supervision and separate control of horns and strobes over a single pair of wires. The controlling channel (SLC) digitally communicates with each appliance and receives a response to verify the appliance’s presence on the channel. The channel provides a digital command to control appliance operation. SLC channel wiring shall be unshielded twisted pair (UTP), with a capacitance rating of less than 60 pf/ft and a minimum 3 twists (turns) per foot.
  - 2. Class B (Style 4) notification appliances shall be wired without requiring traditional in/out wiring methods; addressable “T” tapping shall be permitted. Up to 63 appliances can be supported on a single channel.
  - 3. Each addressable notification appliance shall contain an electronic module and a selectable address setting to allow it to occupy a unique location on the channel. This on-board module shall also allow the channel to perform appliance diagnostics that assist with installation and subsequent test operations. A visible LED on each appliance shall provide verification of communications and shall flash with the appliances address setting when locally requested using a magnetic test tool.



- B. Addressable Controller: Addressable controller shall supervise channel (SLC) wiring, communicate with and control addressable notification appliances. It shall be possible to program the High/Lo setting of the audible (horn) appliances by channel from the addressable controller.
- C. Horn: Addressable horn shall be listed to UL 464. Horn appliances shall have a High/Lo setting, programmable by channel from the addressable controller or by appliance from the host FACP. The horn shall have a minimum sound pressure level of 83 or 89 dBA @ 24VDC. The horn shall mount directly to a standard single @ 24VDC. The horn shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot.
- D. Visible/Only: Addressable strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. V/O appliances shall be provided with different minimum flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/only appliance.
- E. Audible/Visible: Addressable combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 83 or 89 dBA @ 24VDC. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. The appliance shall be capable of two-wire synchronization with one of the following options:
1. Synchronized Strobe with Horn on steady.
  2. Synchronized Strobe with Temporal Code Pattern on Horn.
  3. Synchronized Strobe with march Time cadence on Horn.
  4. Synchronized Strobe firing to NAC sync signal with Horn silenced.
- F. Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs.

The following functionality shall be included in the isolator module.

1. Report faults to the host FACP.
2. On-board Yellow LED provides module status.
3. After the wiring fault is repaired, the isolator modules shall test the lines and automatically resort the connection.

G. Accessories: The Contractor shall furnish the necessary accessories.

## 2.09 SYSTEM WIRING METHODS

<b>SCHEDULE "A"</b>		
<b>INTERIOR FIRE ALARM SYSTEM WIRING METHODS (NOTE 1)</b>		
<b>TYPE CIRCUITS (NOTE 2)</b>	<b>WIRING (NOTES 3 &amp; 4)</b>	<b>RACEWAY</b>
Power limited NAC, SLC	FPL for SLC and Audible NAC. FPL or THHN/THWN or TFN for Visual NAC.	See Note 5.
Fire Safety Control Circuits (fan control/shutdown, etc.)	TFN or THHN/THWN (No. 12 AWG for 120 VAC and No. 16 AWG for 24 VDC with addressable control relay modules)	See Note 5.
SLC between main FACP and remote annunciators	Fiberoptic	

### NOTES:

1. Follow NEC for special local conditions (i.e., wet, underground, etc.).
2. NAC = Notification Appliance Circuits; SLC = Signaling Line Circuits.
3. Not less than No. 18 AWG for SLC; Not less than No. 14 AWG for audible NAC and No. 12 AWG for visual NAC.
4. No splices permitted in conductors. Continuous conductors between system devices, terminal strips mounted in red labeled terminal cabinets/junction boxes and control unit.
5. Surface raceway permitted for drops to wall surface-mounted devices and appliances below ceiling. Minimum 1/2" EMT in mechanical and electrical spaces. Plenum rated cable without raceway above ceilings.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. System installation shall be in accordance with manufacturer's instructions; utilize terminal strip cabinets and install wiring in a separate and segregated raceway system. Clearly identify wiring in terminal strip cabinets and boxes.

- B. Wiring shall comply with NEC Article 760 and manufacturer's instructions; and performed by qualified personnel experienced in this type of work.
- C. Wiring installed without raceway above ceiling shall be attached to structural elements (including ceiling grid) using approved attachment methods. Wiring shall not be laid across the ceiling or supported by other raceways or equipment. Plastic wire ties are not permitted.
- D. Installation shall be in accordance with referenced standards and the following:
  - 1. Fire alarm and detection system wiring shall be installed in surface raceway in exposed areas where wiring can not be concealed above accessible ceiling space.
  - 2. All 120 volt wiring shall be in raceway separate from 24 volt wiring.
  - 3. Provide wiring and relay from addressable control module to HVAC fan motor starter controller. Duct smoke detectors shall be mounted on the ventilating ductwork by Division 16. All mounting arrangements, holes cut into ductwork, sealing of openings along with ceiling and access doors for the duct type detectors shall be by Division 16. Provide duct detectors with sampling tubes and end caps.
  - 4. Provide notification appliances with integral 15 candela strobe as noted on drawings.
  - 5. Program heat detector alarm threshold of 135°F unless otherwise noted.
  - 6. Provide 72 hour (3 business days) written notification prior to performing system tests, notify the Owner, Engineer and public emergency services dispatch center to avoid inadvertent fire department response to fire alarm signals.
  - 7. Coordinate proposed work areas and times with the facility at least 72 hours in advance of start of work.
  - 8. Mount addressable zone module and addressable control module in 4 x 4 junction box within 3 feet of duct smoke detector.
- E. Contractor shall repair to match existing areas where existing fire alarm devices and equipment are removed from finished spaces.
- F. Surface mounted devices shall be mounted on a suitable box. Total assembly shall be secure, smooth contour and have no protrusions.
- G. Where detectors are installed on wood or masonry surfaces, attach brackets directly to the surface with tamper-proof fasteners. Where detectors are installed on suspended ceilings, provide additional supports in the ceiling, such as channel support system, angle iron or additional runner bars. Fasten the additional supports rigidly to the ceiling runner bar system. Attach bracket to the supports with tamper-proof fasteners. Install metal spacers between the bracket and supports so that ceiling tiles will not be a part of the support system.

- H. Smoke detectors shall be field checked and set to meet the prevailing conditions of the premise. All such work shall be performed by an authorized representative of the manufacturer trained in such procedures.
  - 1. Protect smoke detectors from airborne dust and debris until completion of all work.

### 3.02 TESTS

- A. Perform tests per NFPA 72 for system and for supervising station reporting system. Use documentation and format indicated in NFPA 72. Any defects identified during testing shall be repaired by appropriate corrective action. Tests shall be repeated until the complete fire alarm systems meet all Contract requirements. Building will be tested, accepted and connected to the main fire alarm control unit in the Main Building as soon as each building is completed. Test shall be in accordance with Section 1.8.
- B. Final fire alarm testing and change over shall be coordinated with Owner and Engineer.

### 3.03 WARRANTY

- A. Base bid shall include 1 year warranty on testing and maintenance of equipment and labor provided under this project. Warranty period shall commence upon final payment to the Contractor.

### 3.04 INSPECTION, TESTING AND MAINTENANCE

- A. Base Bid shall include 2 year inspection, testing and preventative maintenance services required by NFPA 72 Section 7-3.

### 3.05 SPARE PARTS

- A. Furnish the following spare parts to the Owner prior to final acceptance:
  - 1. Analog addressable smoke sensors – 3 devices.
  - 2. Duct smoke sensors with associated remote alarm indicators and test switch – 2 devices.
  - 3. Addressable manual fire alarm pull stations – 1 device.
  - 4. Visible notification appliances – 3 devices.
  - 5. Audible/visible notification appliances – 2 devices.

### 3.06 TRAINING

- A. Provide a minimum of two (2) four-hour training sessions for training of County personnel. Training sessions shall be as scheduled by Owner to include shift personnel. Contractor shall provide minimum of one session for training of 2nd and/or 3rd shift personnel as directed by Owner.

END OF SECTION