



**HENRY FORD COLLEGE  
SEALED BID #23269**

**CONTRACT DOCUMENTS  
FOR  
LOCKER ROOM RENOVATION**

**Due Date: Monday, May 27, 2024 at 2:00 p.m.**

Architect  
DiClemente Siegel Design Inc.  
Robert W. Armstrong  
VP Architecture  
Tel: 248-569-1430 x 302  
Email: [RArmstrong@DSDONLINE.COM](mailto:RArmstrong@DSDONLINE.COM)

Owner:  
Henry Ford College  
Dan Murray  
Purchasing Director  
Tel: 313-845-6420  
E-mail: [fred@hfcc.edu](mailto:fred@hfcc.edu)

**SEALED BID #22161  
LOCKER ROOM RENOVATION**

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**BID NOTICE**

Henry Ford College  
Dearborn, Michigan

**REQUEST FOR BIDS**

The Board of Trustees of Henry Ford College hereby invites the submission of Sealed Bids for the Locker Room Renovation project from qualified, responsible contractors with the ability to perform successfully under the terms and conditions of the proposed procurement.

A mandatory bidders' conference will be held on Tuesday, May 7, 2024 at 10:00 a.m. in the Facilities Services Building, Conference Room D-101, at Henry Ford College, 5101 Evergreen Road, Dearborn, Michigan. Bid documents are available at <https://www.bidnetdirect.com/mitn/hfcc>.

The College will receive bids online until 2:00 p.m. on Monday, May 27, 2024 at HFC's Bidnet Direct page, <https://www.bidnetdirect.com/mitn/hfcc>, at which time and place all bids will be publicly opened and read aloud. The College will not consider or accept a response received after the date and time specified above. The right to reject any and/or all bids is reserved. Any bid submitted will be binding for at least sixty (60) days subsequent to the date of the bid opening.

Any bid submitted will be binding for at least ninety (90) days after the date of the bid opening.

BOARD OF TRUSTEES  
HENRY FORD COLLEGE  
Dearborn, Michigan 48128-1495  
By Irene Watts, Secretary

**SEALED BID # 23269  
LOCKER ROOM RENOVATION  
INSTRUCTIONS TO BIDDERS**

1. GENERAL:

Henry Ford College (hereinafter referred to as the College or HFC) seeks proposals from qualified and experienced contractors to provide the construction materials and services described in this specification and its attachments. Proposals shall be submitted online on forms furnished by the College (and attached herein).

Submit one (1) signed copy of your proposal at <https://www.bidnetdirect.com/mitn/hfcc>.

It is the responsibility of the bidder to see that its bid is received in the proper time. Any bid received after the scheduled closing time for receipt of bids shall not be considered.

Each proposal shall give the prices proposed in the manner required by the proposal and shall be signed by the bidder or the bidder's duly authorized representative, with its address and telephone number. If the proposal is made by an individual, the individual's name, postal address, and telephone number must be shown. If made by a partnership, the proposal shall have the signature of all partners or an affidavit signed by all partners empowering one partner as an agent to act in their behalf and the address and telephone number of the partnership. A proposal submitted by a corporation shall show the name of the state in which the corporation is chartered, the name of the corporation, its address and telephone number, and the title of the person who signs on behalf of the corporation.

2. CLOSING DATE FOR BIDS:

Bids will be received until: **Monday, May 27, 2024 at 2:00 p.m.**

3. PROPOSAL SUBMISSION:

Any bid may be withdrawn at any time prior to the time fixed in the public notice for the opening of bids but only by a written request from the bidder or its authorized representative filed with the College. An oral request to withdraw a bid proposal is not acceptable. The withdrawal of a bid shall not prejudice the right of a bidder to file a new bid. This paragraph does not authorize the withdrawal of any bid after the time fixed in the public notice for the opening of bids.

After the bid opening date and time, proposals will be considered as final and no alternative or revised proposal will be accepted.

A public opening will be held in the HFC Purchasing Department. Proposals will be opened and the names of the bidders will be read aloud on the date and time indicated in the bid specification above, Item #2. Proposals will remain confidential until notice of intent to award is made, at which time the documents will become public.

4. WITHDRAWAL OF BIDS:

Any bidder may withdraw their bid at any time prior to the scheduled time for the receipt of bids. No bid may be withdrawn after the scheduled closing time for receipt of bids for at least ninety (90) days. The College reserves the right to reject any or all bids and waive any informality, when in the best interest of the College it is deemed advisable.

5. BASIS OF PROPOSALS:

Proposals shall be based on the methods and materials shown on the drawings or described in the specifications. If the bidder wishes to bid on alternate construction methods, materials, or pieces of equipment other than specified, he shall submit a separate proposal on the alternate methods, materials or equipment apart from the base bid. The College reserves the right to re-bid a portion of the bid, or the entire bid, based on the alternatives proposed.

The College reserves the right to waive any and all technicalities and to waive any defect in a bid which does not materially alter the specifications; accept the whole, part of, or reject any or all quotations; and to select the firm which, in the sole opinion of the College, best meets the College's needs. The College also reserves the right to negotiate with potential Bidders so that its best interests are served.

6. MANDATORY BIDDERS' CONFERENCE:

All firms who wish to bid this job are required to attend the mandatory bidder's conference on **Tuesday, May 7, 2024 at 10:00 a.m.** in the Facilities Management Building, Conference Room D-101, at Henry Ford College, 5101 Evergreen Road, Dearborn, Michigan (see the Attachment titled "Campus Map" for the location). **The bidder is responsible for knowing the existing conditions.**

7. INTERPRETATION OF CONTRACT DOCUMENTS:

If any person contemplating submitting a bid for the proposed contract is in doubt as to the true meaning of any part of plans, specifications, or other proposed contract documents, he may submit to the Owner a written request for an interpretation thereof.

The person submitting the request will be responsible for its prompt delivery. Any interpretation of the proposed documents will be made only by addendum duly issued and a copy of such addendum will be mailed or delivered to each person receiving a set of such documents.

8. BIDDER'S RESPONSIBILITY FOR CONDITIONS OF WORK AT SITE:

It is necessary for bidders to inform themselves of the conditions under which the work is to be performed, the site of the work, the obstacles which may be encountered, and all other relevant matters concerning the work to be performed. No claim for additional compensation will be allowed due to unfamiliarity with the specifications and/or existing conditions. It shall be understood that the Bidder has full knowledge of all the specifications and accepts them "as is."

Any notations shown on the documents are for general information purposes only and are not intended to relieve the Bidder of his responsibility of investigating all local conditions affecting his work.

No plea of ignorance of conditions which exist, of which may hereafter exist, or of any difficulties which may be encountered will be accepted as the basis for any failure or omission on the part of the Bidder to fulfill all of the requirements of this contract.

9. BIDDERS QUALIFICATIONS:

No proposal will be considered from any bidder unless known to be skilled and regularly engaged for a minimum of three years in work of a character similar to that covered by the Contract Documents.

**The bidder's response shall include a list of similar projects that the bidder has in progress or has completed in the past five years. Include the name of project, owner, owner's contact & phone, description of the project, contract amount, percent complete, and (scheduled) completion date. References from local and higher education projects are preferred.**

If necessary, the bidder might also be asked to furnish, within forty-eight hours after being requested by the Owner to do so, additional evidence of the bidder's experience, resources, and financial ability to properly execute the proposed work to completion within the specified time. The evidence requested may include, but is not limited to, the following:

- a. Address of the Bidder's permanent place of business.
- b. The Bidder's performance records (all work awarded to or started by firm within the past three years).
- c. An itemized list of the Bidder's equipment available for use on the project.
- d. The Bidder's financial statement, including statement of ownership of equipment necessary to be used in project work under the contract.
- e. Any other information to satisfy the Owner that the Bidder is adequately prepared to fulfill the contract.

10. REQUIREMENTS FOR SIGNING BIDS:

Bids which are not signed by individual making them should have attached thereto a power of attorney evidencing authority to sign the bid in the name of the person for whom it is signed.

Bids which are signed for a partnership should be signed by one of the partners or by an attorney-in-fact. If signed by an attorney-in-fact, there should be attached to the bid, a power of attorney evidencing authority to sign the bid, executed by the partners.

Bids which are signed for a corporation should have the correct corporate name thereon and the signature and printed name of the president or other authorized officer of the corporation.

11. WHEN THE AWARD IS EFFECTUAL

The Contract shall be deemed as having been awarded when formal notice of the award shall have been duly served upon the intended awardee (i.e., the bidder whom the Owner contemplates awarding the contract) by some officer or agent of the Owner duly authorized to give such notice.

The final contract award may be subject to approval by the Henry Ford College Board of Trustees.

12. NUMBER OF COUNTERPARTS OF CONTRACT AND BONDS REQUIRED:

Contractor to whom contract is awarded shall execute three (3) copies of the contract and bonds as required in the specifications.

13. CONTRACT BONDS:

Not required.

14. BID BOND OR CERTIFIED CHECK(S):

Proposals must be accompanied by a bidder's bond by an authorized surety company or a certified check made payable to the Henry Ford College, in the amount of 5% of the proposal submitted.

15. RETURN OF BID DEPOSITS

The bid deposits of all except the three lowest bidders will be returned within five (5) working days after the opening of the bids. The bid deposits of the three lowest bidders will be returned within forty-eight hours after the executed contract and required bonds have been finally approved by the Owner.

16. PROJECT SITE:

The project site(s) for the proposed work:

Henry Ford College  
Main Campus, Building H (Athletic Memorial Building)  
5101 Evergreen Road  
Dearborn, Michigan 48128

Storage space and staging areas are limited at this site. Bidder must coordinate these needs with the Project Manager for Henry Ford College.

17. GENERAL SCOPE OF WORK:

Except as otherwise specifically stated in the contract documents, the contractor shall provide and pay for all materials, labor, tools, equipment, superintendence, and all other services and facilities of every nature whatsoever necessary to execute, complete and deliver the work within the specified time, for work specified in the specifications.

18. TIME OF COMPLETION:

The Bidder shall be prepared to begin work immediately upon award of the Contract and shall proceed expeditiously without necessary delay, maintaining his work force on the project until completion.

Tentative Milestone Dates are as follows:

Mandatory Bidder's Meeting: May 7, 2024 at 10:00 a.m.  
Deadline for Questions & RFI's: May 15, 2024 by 4:00 p.m.  
Response to Questions Issued: May 20, 2024 by 4:00 p.m.  
Bid Due Date: May 27, 2024 at 2:00 p.m.  
Board Approval of Award: June 10, 2024  
Purchase Order Issued: June 11, 2024  
Work Begins: As soon as practical  
Substantial Completion: September 1, 2024

Work schedule shall be coordinated with the Project Manager for Henry Ford College so as not to interfere with events which may be scheduled in the subject work area.

19. EQUAL OPPORTUNITY & NON-DISCRIMINATORY:

Henry Ford College, as an Equal Opportunity Employer, complies with applicable federal and state laws prohibiting discrimination including Title IX of the Education Amendments of 1972 and Section 503 of the Rehabilitation Act of 1973. The College does not discriminate in any educational program, activity, or employment practice on the basis of age, race, sex, age, color, religion, national origin, marital status, political affiliation or belief, weight, height or handicap. In connection with the performance of work under this contract, the successful Vendor and its subcontractors, if any, shall insure that the evaluation and treatment of employees and applicants for employment are free of such discrimination.

20. SUBCONTRACTORS

At the time of public bid opening all bidders are required to provide a list of all subcontractors. Failure to specify subcontractors on bid documents will result in an incomplete bid. Henry Ford College reserves the right to reject bids based upon subcontractors specified by bidder. Bidder must notify Henry Ford College of any changes in subcontractors. No changes can be made in subcontractors from the approved list without the permission of Henry Ford College. Failure to do so will constitute grounds for termination of the contract.

The terms and conditions of the contract shall cover all contracts made by the successful bidder with subcontractors. The successful Bidder shall assure that all subcontractors are fully informed regarding these terms and conditions.

21. IRAN-LINKED BUSINESS CERTIFICATION:

Each Contractor submitting a proposal on this project shall include a letter with their proposal certifying that they have full knowledge of the requirements and possible penalties under the law MCL 129.311 et seq., that the Contractor is NOT an IRAN LINKED BUSINESS, as required by MCL 129.313 et seq., and as such that Contractor is legally eligible to submit a bid and be considered for a possible contract to supply goods and/or services to Henry Ford College.

**Firms submitting a proposal MUST include a completed Bidder Certification Form. Use the Attachment titled "Iran-Linked Business Certification."**

22. HFC CONTACTS:

Purchasing Department:

Dan Murray  
Purchasing Director  
Tel: 313-845-9897  
Email: [dmurray8@hfcc.edu](mailto:dmurray8@hfcc.edu)

Questions regarding specifications, scope of work or bid procedures should be directed to the Purchasing Director. Purchasing will send written instruction or addendum to all bidders. The College will not be responsible for oral interpretations.

Facility Services Department:

Tanusree Coomar  
Project and Construction Coordinator  
Tel: 313-317-6537  
E-mail: [tcoomar@hfcc.edu](mailto:tcoomar@hfcc.edu)

Project Architect:

DiClemente Siegel Design Inc.  
Robert W. Armstrong  
VP Architecture  
Tel: 248-569-1430 x 302  
Email: [RArmstrong@DSDONLINE.COM](mailto:RArmstrong@DSDONLINE.COM)



## **GENERAL CONDITIONS OF WORK**

### **COORDINATION OF WORK**

The vendor shall notify the College at least five (5) days prior to commencement of such work. Work shall be performed in a professional like manner. Vendor shall coordinate the timely completion of the work. All debris shall be removed from the work site and the premises left in a clean condition at the conclusion of each workday.

### **SAFETY**

The Bidder shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with this work. The Bidder shall give and post all notices and comply with all applicable laws, ordinances, rules, regulations, and lawful orders of any public authority bearing on the safety of persons and property or their protection for damage, injury, or loss.

### **SCAFFOLDING, LADDERS, HOISTS, ETC.**

The Bidder or its subcontractors shall furnish at its own cost and expense all scaffolding, trestles, ladders, hoists, and platforms and all other equipment which is required for the execution of the work under this Project.

### **ASBESTOS**

In all working relating to this Contract, the Bidder shall visually inspect all material to determine if said material should be tested for the presence of asbestos. If these materials appear to contain asbestos, work shall not take place until such materials are tested in accordance with the provisions of the Asbestos Hazard Emergency Response Act and such regulations relating thereto. The testing of such materials such be performed and paid for by the Owner upon notification by the Bidder.

If said material testing reveals the presence of asbestos, then the removal of such materials shall be the responsibility of the Owner. The cost for the removal shall be borne by the Owner.

### **DISPOSITION OF EQUIPMENT AND MATERIALS**

Materials removed but not salvaged for reuse may remain the property of the Owner. Bidder will review all salvageable items with Owner prior to the start of the Project. Owner will instruct Bidder where selected items are to be delivered for storage on site. All unselected items shall be disposed of by the Bidder off the site.

### **LATEST EDITIONS OF STANDARDS**

Where standards or specifications of societies, government agencies, manufacturers, and others are specified herein, it shall be understood that the latest published editions at the time of the receipt of the proposals shall apply to the work.

## SUPPLEMENTAL TERMS & CONDITIONS

The College reserves the right to waive any irregularities; accept the whole, part of, or reject any or all quotations; and to select the firm which, in the sole opinion of the College, best meets the College's needs. The College also reserves the right to negotiate with potential Bidders so that its best interests are served.

The College cannot be responsible for any expenses incurred in the preparation of any proposal or presentation, nor does the College assume any contractual obligations by issuing this solicitation.

**Indemnity/Hold Harmless Agreement:** Each party shall be responsible for its own acts and the results thereof and shall not be responsible for the acts of the other party and the results thereof. Each party, therefore, agrees, to the extent authorized by applicable state or federal statute, that it shall assume all risk and liability to itself, its respective board members, officers, employees, or agents from any and all claims, demands, judgments and expenses, including attorney fees, from any and all loss, damage, or injury, to person or property, or death arising from any negligent action or omission by itself or its own agents related to (a) the Agreement, (b) the activities authorized by this Agreement, or (c) the use or occupancy of the premises, project area, or facilities that are the subject of this Agreement.

The College is committed to equal employment and educational opportunities regardless of a person's age, race, color, religion, marital status, sex/gender, pregnancy, sexual orientation, gender identity, gender expression, gender transitioning, height, weight, national origin, disability, perceived disability, political affiliation, familial status, veteran status, genetics or other characteristic protected by law in all College programs, services, activities, employment and advancement, including without limitation educational admissions practices, and access to, equitable treatment or employment compensation and benefits as required by state and federal laws. In accordance with state and federal law and local ordinances, the College prohibits and will not tolerate any form of discrimination. In connection with the performance of work under this contract, the successful Bidder and its subcontractors, if any, shall insure that the evaluation and treatment of employees and applicants for employment are free of such discrimination.

In general, Henry Ford College is a tax-exempt institution, granted such status by authorized taxing units of the State of Michigan, and is exempt from Federal Excise Tax (tax exemption number 20-0027170) and Michigan General Sales Tax (Public Act 167 of 1933, Section 4, as amended). However, building materials for use or consumption in the performance of a construction contract are subject to State of Michigan sales or use taxes.

### Certification Regarding Debarment, Suspension, and Other Responsibility Matters:

- A. The undersigned certifies to the best of his/her knowledge and belief that the firm submitting this bid and its principals:
  - i. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded by any Federal or State of Michigan (State) department or agency;
  - ii. Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
  - iii. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph 1b of this certification; and
  - iv. Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.
- B. Where the undersigned is unable to certify to any of the statements in this certification, such prospective bidder shall attach an explanation to this proposal.

**BIDDER’S INSURANCE REQUIREMENTS**

The Bidder and (except for limits) all sub-contractors shall procure and maintain during the life of this contract the following insurance coverage, underwritten by insurers admitted and licensed to do business in the State of Michigan and rated at least "A-" by A.M. Best.

1. Workers' Compensation Insurance, including Employers Liability Coverage, in accordance with all applicable statutes of the State of Michigan. The Employers Liability limit of insurance shall be not less than \$1,000,000.
  
2. Commercial General Liability Insurance or equivalent, on an "Occurrence" basis including coverage for Bodily Injury, Property Damage, Personal Injury, Contractual Liability, Products and Completed Operations, Independent Contractors Coverage, and Broad Form General Liability Extensions or Equivalent, Deletion of all Explosion, Collapse and Underground (XCU) Exclusions, if applicable. Limits of insurance shall be not less than the following:
 

General Aggregate -	\$ 2,000,000
Products & Completed Operations -	\$ 1,000,000
Personal & Advertising Injury -	\$ 1,000,000
Each Occurrence -	\$ 1,000,000
Fire Damage (any one fire) -	\$ 50,000
Medical Expense (any one person) -	\$ 5,000
  
3. Motor Vehicle Liability Insurance, including Michigan No-Fault coverage, with limits of liability of not less than \$1,000,000 per occurrence combined single limit for Bodily Injury and Property Damage. Coverage shall include all owned vehicles, all non-owned vehicles, and all hired vehicles.
  
4. Additional Insured: Commercial General Liability and Motor Vehicle Liability Insurance, as described above, shall include an endorsement naming the College as an Additional Insured.
  
5. Cancellation Notice: Workers Compensation Insurance, Commercial General Liability Insurance and Motor Vehicle Liability Insurance, as described above, shall include an endorsement stating the following:  
*"It is understood and agreed that thirty (30) days Advance Written Notice of Cancellation, Non-Renewal, Reduction and/or Material Change shall be sent to: Facility Services Director, Henry Ford College, 5101 Evergreen Road, Dearborn, MI 48128."*
  
6. Certificates of Insurance shall be filed with the College at least 14 days prior to the commencement of the work. These certificates and the insurance policies required above shall contain a provision that coverages afforded under the policies will not be canceled, reduced, materially changed, or allowed to expire until at least 30 days prior written notice has been given to the College. Should any insurance policy required above be due to expire during the Contract term, the Bidder shall file with the College certificates if insurance evidencing renewal of such coverage at least 14 days prior to the policy expiration.



Facilities Services  
February 2009

### **CONTRACTOR CODE OF CONDUCT**

The purpose of the Henry Ford College and its employees is to provide a safe, positive learning environment for the students of the College. In providing that environment it is mandatory that all employees, visitors, and contractors follow certain levels of conduct, dress, and demeanor. This Code of Conduct outlines the expectations of the Henry Ford College for persons both contemplating performing work and performing work for Henry Ford College in the capacity of a contractor or subcontractor. These rules will become part of the mandatory working conditions of the contract and failure to comply by any contractor, subcontractor, management, employee, or contracted consultant may result in the cancellation of the contract.

In general it is expected that everyone entering a Henry Ford College facility, whether a school, support facility, or the surrounding grounds, must dress, act, and talk in a manner that is conducive to the education process while assuring overall safety and security. The following rules have been established to assure that this is done:

1. Every contractor and subcontractor employee that enters or leaves the building must sign in and out at the Facilities Services office or as designated by the Director – Facilities Services. This sign in sheet must record the name, time in and out, the firm, and the signature of the individual.
2. All contractors shall be furnished by their company a badge or identification that is to be worn while in the building. Such identification shall clearly indicate the individual's name and the name of the firm they are working for.
3. Prior to the beginning of a job, the contractor shall furnish the Director – Facilities Services or designee with a list of individuals expected to be on the job, contact persons with phone numbers, and a schedule of the activities to take place.
4. The contractor shall provide the Director – Facilities Services or designee with a scope of work prior to drilling or penetrating any walls, floors, or ceilings. All penetrations must be returned to original condition at the completion of the project or as needed to provide for safety of occupants.
5. Each person working in a College building or on College grounds shall comply with the following:
  - No drinking or possession of liquor or alcoholic beverages and or possession of any kind of illicit drugs or narcotics.
  - No use of College facilities or equipment including telephone, computers, internet access, fax, kitchen, maintenance or office equipment.
  - Parking for contractor and sub-contractor employees is restricted to areas designated by the Director – Facilities Services or designee.
  - Delivery of tools, materials and supplies to the worksite is subject to restriction by the Director – Facilities Services and the Manager – Campus Safety or designees.
  - No smoking or use of any tobacco products anywhere within the building at anytime nor outside the school on College property during normal school hours,
  - A reasonable standard of dress must be followed. Within the educational facilities where students, faculty, staff and visitors are or can be present, this is to mean clothing or attire must be suitable for the work and must not bear images or writing depicting anything to be construed as obscene in nature or promoting or portraying alcoholic beverages or use, drugs, narcotics, tobacco or establishments that serve or promote the use of these substances.
  - There shall be no use of profanity or obscene language or gestures.
  - Language, gestures, or other actions that depict sexual or ethnic harassment or intimidation will not be permitted.

6. The contractor is responsible for a clean and safe workplace. To that end the following will be adhered to:
- All work areas, walkways, and stairs must be kept clear of debris and loosely scattered materials.
  - Material storage is to be in an area designated by the Director – Facilities Services or designee.
  - All work areas are to be cleaned by the contractor prior to leaving. Building staff will not be responsible for cleaning work areas.
  - All trash, debris, and material must be removed from the worksite each day and disposed of off site. College dumpsters and trash containers are not to be used by contractors for disposal.
  - All contractor tools and equipment must be kept in good working order, with guards and safety devices in place and working. Defective tools must be taken out of service. College tools and equipment will not be loaned to contractors.
  - Contractors are to provide and use required protective safety equipment and comply with all local, state, and federal safety laws and regulations.
  - Contractors are responsible for the reporting of accidents both to the College and their management and to obtain any emergency treatment that may be required.
  - Upon leaving a jobsite all doors and windows must be locked, secured, or left as they were found prior to beginning the work.
  - Contractors are to provide their own site safety plan for areas in which they are working.
  - Contractors are reminded that there are asbestos-containing materials in our buildings. They are not to disturb any insulation or enter any areas that contain asbestos-containing building materials. If they have any questions, contact the Director – Facilities Services or designee for direction.
  - Contractor is not to disable or interfere with any fire or burglary system equipment or telephone lines servicing such equipment. If equipment needs to be removed, relocated, or temporarily disabled, the contractor needs to coordinate this with the Director – Facilities Services or designee.
7. The College will not tolerate acts of theft, vandalism, fighting, or abuse of the facilities or activities that threaten the security and safety of the school environment and its students, staff, and employees.

In summary, good judgment must be used to protect the learning environment. **Failure to comply with the above—or to exhibit conduct which is deemed not in the best interest of Henry Ford College—will be grounds for immediate removal from the College grounds and the project.**

## SCOPE OF WORK

### A. SUMMARY:

Henry Ford College (HFC) seeks to renovate the existing Women's Locker Room in the Athletic Room (Building H) on main campus located in Dearborn, Michigan. The scope of work will include, but not be limited to, any associated demolition work and renovation work for the creation of a student locker area, team locker area, coaches' area, and training area. The project will be constructed in one phase depending upon the Owner's approved budget.

### B. SCOPE OF WORK:

The scope of the Contractor's work shall include:

- 1) Protect existing walls, doors, wall, and floor tile, etc. during the entire project.
- 2) Demolition of existing lockers, locker base, benches, walls, flooring, wall tile, wall base, ceilings, mechanical (diffusers, etc.), electrical items (light fixtures, etc.) within the area of work and as indicated on the drawings. Discard all materials off-site per local and state ordinances and codes.
- 3) Provide concrete infill at all existing locker base removal areas for a flush condition. Provide flush condition at all existing bench support removal locations. Repair any existing floor conditions as required by the Flooring Manufacturer and as noted on the documents. Prepare existing floor as required by the Flooring Manufacturer and as noted on the documents.
- 4) Construct and install all new walls, ceilings, doors/fames, flooring, base, millwork, sound insulation, finishes and furniture as shown on documents and specifications.
- 5) Supply and Install Mechanical, Electrical, and Plumbing work. See documents and specifications.
- 6) Be responsible for the execution of this contract, including materials and workmanship of any firm acting as subcontractor. The Contractor shall be responsible for providing subcontractor(s) with complete and up to date drawings, specifications, or other information issued by the Architect or the College.
  - A. If the Contractor chooses to subcontract any installation service or other portion of this specification, the Contractor shall fully warrant prompt performance of the subcontractor in a fully complete, workmanlike manner customary to the trade.
  - B. Failure by the subcontractor to perform in a timely manner shall not relieve the Contractor of its obligations to make the complete and timely delivery of the products or services specified herein at no additional cost to HFC.
- 7) Coordinate installation schedules with the College. The College will work closely with the Contractor to provide all information necessary for the Contractor to meet deadlines.
- 8) Assign a project manager to the project who shall be responsible for all aspects of the work. The Contractor shall notify the College's designee of all work schedules and timelines. The College reserves the right to reject the Contractor's proposed project manager without penalty and to request a substitution.
- 9) Exercise due care throughout the installation and repair any damage to HFC property caused by the Contractor's workforce.
- 10) Store all equipment and materials at the Contractor's location until ready to begin work. There are no storage sites available at the College prior to the start of the work.

**C. OTHER PROVISIONS:**

- 1) If the Bidder chooses to subcontract any installation service or other portion of this specification, the Bidder shall fully warrant prompt performance of the subcontractor in a fully complete, workmanlike manner customary to the trade. Failure by the subcontractor to perform in a timely manner shall not relieve the Bidder of its obligations to make the complete and timely delivery of the products or services specified herein at no additional cost to HFC.
- 2) HFC will provide the Contractor with access to all facilities and utilities needed to complete the installation.
- 3) Provide the best pricing available. HFC belongs to the following group purchasing organizations:
  - A. CHAMPS Group Purchasing
  - B. Choice Partners Cooperative
  - C. Educational and Institution Cooperative Services (E&I)
  - D. Equalis Group/Sourcing Alliance
  - E. Midwestern Higher Education Compact (MHEC)
  - F. NASPO ValuePoint (National Association of State Procurement Officials)
  - G. National Cooperative Purchasing Alliance (NCPA)
  - H. OMNIA Partners, Public Sector (fka: National IPA and U.S. Communities)
  - I. Premier Group Purchasing (PremierConnect)
  - J. Regional Educational Media Center Association of Michigan (REMC Statewide Bid Project)
  - K. Sourcewell (fka: National Joint Powers Alliance – NJPA)
  - L. State of Michigan Extended Purchasing Program (MiDEAL)
  - M. TIPS Purchasing Cooperative (Interlocal Purchasing System)

**D. PROPOSAL SUBMISSION:**

**BID PROPOSAL FORM  
DUE: MAY 27, 2024 AT 2:00 P.M.**

OWNER: Henry Ford College  
5101 Evergreen Road  
Dearborn, Michigan 48128-1495

PROJECT: Bid # 23269  
Locker Room Renovation

COMPANY NAME: \_\_\_\_\_

CONTACT NAME: \_\_\_\_\_

PHONE/FAX: \_\_\_\_\_

E-MAIL: \_\_\_\_\_

The undersigned, being familiar with the local conditions affecting the cost of the work and with the contract documents, including General Conditions, Modifications to General Conditions, Bid Proposal Form, Drawings, Specifications and Addenda, hereby proposes to furnish all design, labor, equipment, materials, tools, parts and services necessary to complete the work in accordance with contract documents as prepared by Henry Ford College, within the time set forth herein, for the total sums stated below:

**BASE BID:**

\_\_\_\_\_ Dollars (\$ \_\_\_\_\_ )  
(sum written out)

COST BREAKDOWN OF BASE BID: Identify the sum for each component listed below.

<b><u>Description</u></b>	<b><u>Unit Cost</u></b>
Flooring	_____
Mechanical & Electrical Work	_____
New Walls, Ceilings, Doors/Frames, & Millwork	_____
Finishes and Furniture	_____
Other:	_____
	_____
<b>GRAND TOTAL (must equal Base Bid)</b>	_____



ADDENDA (If any):

The undersigned has included in the proposal the modifications of the work described in the following addenda received prior to the submission of this proposal:

No. \_\_\_\_\_ Dated: \_\_\_\_\_ No. \_\_\_\_\_ Dated: \_\_\_\_\_  
 No. \_\_\_\_\_ Dated: \_\_\_\_\_ No. \_\_\_\_\_ Dated: \_\_\_\_\_

AUTHORIZED CHANGES IN THE WORK:

The undersigned agrees that any authorized changes shall be incorporated in the work for an addition or deduction to the Contract Sum calculated as the total net difference in cost of the work involved in the change (including direct labor costs and benefits) and increased by the following percentages to cover all other charges, taxes, insurance, supervision, overhead and profit.

	<u>Additions</u>	<u>Deductions</u>
For Work Not Under Subcontract (sum not to exceed 10%)	% _____	% _____
For Work Under Subcontract (sum not to exceed 7%)	% _____	% _____

TIME OF COMPLETION:

The Undersigned agrees to commence work operations once room is available and to substantially complete work within \_\_\_\_\_ consecutive calendar days, and that the proposed bid is in full consideration of this.

REFERENCES:

Provide a list of similar projects that the bidder has in progress or has completed in the past five years. Ref: Instructions to Bidders, Paragraph 9, Bidder's Qualifications.

SUBCONTRACTOR IDENTIFICATION:

The Undersigned proposes to use the following subcontractors, subject to final acceptance by the Owner and Designer. Attach additional sheets if necessary.

Trade	Subcontractor – provide company name, contact name, business address, phone number and email address


SUCCESSORS AND ASSIGNS:

The Owner and the Bidder each binds itself, its successors and assigns to the other party to this agreement and to all successors and assigns of such other party with respect to all covenants of this agreement. Neither the Owner nor the Bidder shall assign, sublet, or transfer its interest in this agreement without the written consent of the other. The undersigned hereby declares that he has the legal status as checked below:

( ) Individual

( ) Partnership, having the following partners:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

( ) Corporation, incorporated under the State laws of:

\_\_\_\_\_

and whose signature is affixed hereto, is duly authorized to execute contracts.

Respectfully submitted,

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

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

\_\_\_\_\_

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

City, State, ZIP: \_\_\_\_\_

Phone and Fax: \_\_\_\_\_

E-mail: \_\_\_\_\_

Company Tax ID: \_\_\_\_\_

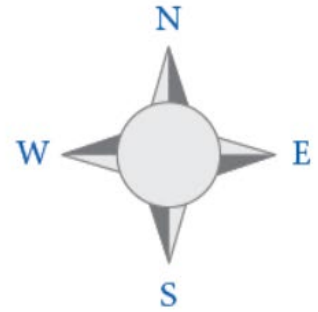
Invoice Terms: \_\_\_\_\_

**ATTENTION: BIDS MUST INCLUDE: 1) THIS COMPLETED AND SIGNED BID PROPOSAL FORM, AND  
2) AN "IRAN-LINKED BUSINESS CERTIFICATION" FORM.**

## LEGEND

-  Emergency Blue Light Phones
-  Handicapped Parking
-  M-Dot Bus Stop
- KF** King Fisher Bluff

- A** Learning Success Center  
Assisted Learning Services  
Career Services  
Counseling  
Learning Lab  
Student Outreach and Support
- B** Eshleman Library  
Media Center
- C** College Store
- D** Facilities Services  
Purchasing  
Shipping and Receiving
- E** Technology Building  
Ghafari Conference Room E-123
- F** MacKenzie Fine Arts Center  
Adray Auditorium  
Sisson Art Gallery
- G** Health Sciences Education Center  
Hackett Conference Room G-150
- H** Athletic Memorial Building  
Fitness Center  
Gym
- I** Child Development Center
- J** Science Building  
Planetarium
- K** Reuther Liberal Arts Building  
English Language Institute
- L** Andrew A. Mazzara Administrative Services and Conference Center  
Forfa Auditorium  
Berry Amphitheater  
Rosenau Board Room (A, B, C)
- M** Student and Culinary Arts Center  
Kuhlmann Dining Room  
Fifty-One O One Restaurant  
Skylight Cafe  
Student Activities  
WHFR Radio Station 89.3 FM
- MT** Michigan Technical Education Center M-TEC
- N** Campus Safety
- SN** School of Nursing
- WC** Welcome Center  
Community Rooms



**M-TEC**  
Michigan Technical Education Center  
3601 Schaefer Rd.

**East Campus**  
Michigan Technical Education Center (M-TEC)  
3601 Schaefer Rd., Building MT, Dearborn  
313-317-6600

HFC School of Nursing  
3601 Schaefer Rd., Building SN, Dearborn  
313-845-6305 or 313-845-9635

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## SECTION 024119 - SELECTIVE DEMOLITION

### 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. Demolition and removal of selected portions of building or structure.
  - 2. Demolition and removal of selected site elements.
  - 3. Salvage of existing items to be reused or recycled.

#### 1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner as may be indicated on the drawings or specified herein..
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

#### 1.4 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

#### 1.5 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 have removed items.



- 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. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
  - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
  - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
- F. Storage or sale of removed items or materials on-site is not permitted.
- G. 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.

## 1.6 WARRANTY

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

## 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/ASSE 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. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or videotapes.

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
  - 1. Comply with requirements for existing services/systems interruptions specified elsewhere.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner or Construction Manager will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. Arrange to shut off indicated utilities with utility companies.
  - 3. 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.
  - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated 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.
    - 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.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - 1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: 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.

### 3.4 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. 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, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
  - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  - 3. 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.
  - 4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  - 5. 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. Store items in a secure area until delivery to Owner.
  - 4. Transport items to Owner's storage area designated by Owner or as indicated on Drawings.
  - 5. 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.

- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
  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.
  4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### 3.6 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 024119

## SECTION 024200– CONSTRUCTION WASTE MANAGEMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
  - 1. Salvaging nonhazardous demolition and construction waste.
  - 2. Recycling nonhazardous demolition and construction waste.
  - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related sections include the following:
  - 1. Division 01 Section “General Requirements – Temporary Facilities and Controls.”

#### 1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations and clearing debris including soil, vegetation, and rocks are not to be included.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Collect, reprocess and reuse of materials diverted or recovered from solid waste stream.
- E. Salvage: Recovery of demolition or construction materials from existing buildings or construction sites and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction materials from existing buildings or construction sites and subsequent incorporation into the Work.

#### 1.4 PERFORMANCE GOALS

- A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling of 50 (75) percent by weight of total waste generated by the Work.

#### 1.5 SUBMITTALS

- A. Waste Management Plan: Submit 3 copies of plan within 14 days of date established for commencement of the Work

- B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit 2 copies of report. Include separate reports for demolition and construction waste. Include the following information:
  - 1. Material category.
  - 2. Generation point of waste.
  - 3. Total quantity of waste in tons.
  - 4. Quantity of waste salvaged, both estimated and actual in tons or cubic yards.
  - 5. Quantity of waste recycled, both estimated and actual in tons or cubic yards.
  - 6. Total quantity of waste recovered (salvaged plus recycled) in tons or cubic yards.
  - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- C. Waste Reduction Calculations: Before request for Substantial Completion, submit 2 copies of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licenses to accept them. Include manifests, weight tickets, receipts, and invoices.
- H. LEED Submittal: LEED letter template for Credit 2, signed by Contractor, tabulating total waste material, quantities and weight (tons) diverted and means by which it is diverted, and statement that requirements for the credit have been met.

#### 1.6 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: LEED Accredited Professional by U.S. Green Building Council, or person familiar and experienced with LEED construction waste management requirements.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section. Review methods and procedures related to waste management including, but not limited to, the following:
  - 1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
  - 2. Review requirements for documenting quantities of each type of waste and its disposition.
  - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.

4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

#### 1.7 WASTE MANAGEMENT PLAN

- A. General: Develop plan consisting of waste identification, waste reduction plan, and cost/revenue analysis. Include separate sections in plan for demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
  1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
  2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses and telephone numbers.
  3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses and telephone numbers.
  4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
  5. Disposed materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number for each landfill and incinerator facility.
  6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.
- D. Plan for and describe the means for securing waste containers from unauthorized users.
- E. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:
  1. Total quantity of waste.
  2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
  3. Total cost of disposal (with no waste management).
  4. Revenue from salvaged materials.
  5. Revenue from recycled materials.
  6. Savings in hauling and tipping fees by donating materials.
  7. Savings in hauling and tipping fees that are avoided.
  8. Handling and transportation costs. Include cost of collection containers for each type of waste.
  9. Net additional cost or net savings from waste management plan.

#### PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 PLAN IMPLEMENTATION

- A. General: Implement waste management plan as approved by Owner. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
  - 1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
  - 2. Observe and follow site measures that prevent cross-contamination of waste. Cross-contamination could render some portion of waste to be non-recyclable, thereby disqualifying the Project from earning LEED Credit MR 2, and the exemplary performance credit of diverting 95% of waste from landfill.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project. The Construction Superintendent may perform the role of the Waste Management Coordinator.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at the Project site.
  - a. Distribute waste management plan to everyone concerned within three days of submittal return.
  - b. Distribute waste management plan to entities upon execution of their contracts. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - a. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
  - b. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

### 3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
  - 1. Clean salvaged items.
  - 2. Pack or crate items after cleaning. Identify contents of containers.
  - 3. Store items in a secure area until installation.
  - 4. Protect items from damage during transport and storage.
  - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: Not permitted on Project site.
- C. Salvaged Items for Owner's Use:
  - a. Clean salvaged items.
  - b. Pack or crate items after cleaning. Identify contents of containers.
  - c. Store items in a secure area until delivery to Owner.



- d. Transport items to Owner's storage area off-site designated by Owner.
  - e. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closes, leave door hardware attached to doors.

### 3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

#### A. General:

- a. Recycle paper and beverage containers used by on-site workers.
  - b. Concrete, masonry, or asphalt crushed and reused are to be identified and include in calculations.
  - c. Exclude hazardous waste from calculations.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
- a. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
    - i. Inspect containers and bins for contamination and remove contaminated materials if found.
  - b. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - c. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
  - d. Store components off the ground and protect from the weather.
  - e. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

### 3.4 RECYCLING CONSTRUCTION WASTE

#### A. Packaging:

- a. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
- b. Polystyrene Packaging: Separate and bag materials.
- c. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
- d. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

#### B. Wood Materials:

- a. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
- b. Clean Sawdust; Bag sawdust that does not contain painted or treated wood.

- C. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.
  - a. Clean Gypsum board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
- D. Metals: Separate metal by type or to meet requirements of recycling receiver or processor.

### 3.5 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  - a. Except as otherwise specified, do not allow excessive on-site accumulation of waste materials.
  - b. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - c. Coordinate with each product manufacturer for take-back programs. Set aside scrap to be returned to manufacturer for recycling into new product.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 024200

SECTION 033543 - POLISHED CONCRETE  
PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation of polished concrete floor system for new and existing interior concrete floors by dry grinding and polishing with various size grit metal-bonded and resin-bonded diamonds and application of concrete densifier.
- B. Concrete polished aggregate finishing system for interior concrete flatwork, including the following:
  - 1. Dry diamond grinding and polishing of concrete floors.
  - 2. Applying densifying impregnator/sealer and polishing to specified sheen level and aggregate exposure.
  - 3. Applying cementitious concrete patch skim coat to problem areas.
  - 4. Applying joint fillers.
  - 5. Types of polished concrete finishes including aggregate finish polished concrete.
  - 6. See 03 30 00 if densifier is to be applied at time of pour and aggregate exposure does not exceed manufacture's recommendation for selected products.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete
- B. Section 079200 - Joint Sealants

1.3 DEFINITIONS

- A. Terminology: As defined by Concrete Polishing Council (CPC) glossary.
- B. Polished Concrete: The act of changing a concrete floor surface, with or without surface exposure of aggregate, to achieve a specified level of appearance.
- C. Bonded Abrasive Polished Concrete: The multi-step operation of mechanically grinding, honing, and polishing a concrete floor surface with bonded abrasives to cut a concrete floor surface and to refine each cut to the maximum potential to achieve a specified level of appearance as defined by the CPC.

1.4 REFERENCE STANDARDS

- A. ANSI/NFSI B101.3 - Test Method For Measuring Wet DCOF Of Common Hard-Surface Floor Materials 2012.
- B. ASTM C779 / C779M - Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces. Latest Edition.
- C. ASTM C805 / C805M - Standard Test Method for Rebound Number of Hardened Concrete, ASTM International, West Conshohocken, PA, 2018, [www.astm.org](http://www.astm.org) Latest Edition.
- D. ASTM D4039 - Standard Test Method for Reflection Haze of High-Gloss Surfaces, ASTM International, West Conshohocken, PA, 2015, [www.astm.org](http://www.astm.org) Latest Edition.
- E. ASTM D5767 - Standard Test Method for Instrumental Measurement of Distinctness-of-Image (DOI) Gloss of Coated Surfaces, ASTM International, West Conshohocken, PA, 2018, [www.astm.org](http://www.astm.org) Latest Edition

- F. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers 2014.
- G. ASTM E1155M - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers (Metric) 2014.
- H. ASTM E303 - Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester 1993 (Reapproved 2013).
- I. ASTM G152 - Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials 2013.
- J. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board 2007.
- K. SCAQMD 1113 - Architectural Coatings 1977 (Amended 2016).
- L. UL 410 - Standard for Slip Resistance of Floor Surface Materials Latest Edition.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Conference: Conduct conference at Project site.
  - 1. Convene one pre-installation meeting. Before start of installation of concrete for polished concrete floor system.
  - 2. Require attendance of parties directly affecting work of this section, including Architect, Contractor, and Installer.
  - 3. Review examination, surface preparation, installation, field quality control, protection, and coordination with other work.
  - 4. Required Attendees:
    - a. Owner.
    - b. Architect.
    - c. Contractor, including supervisor.
    - d. Concrete producer.
    - e. Concrete finisher, including supervisor.
    - f. Concrete polisher, including supervisor.
    - g. Technical representative of liquid applied product manufacturers.
  - 5. Minimum Agenda: Polisher shall demonstrate understanding of work required by reviewing and discussing procedures for, but not limited to, following:
    - a. Tour field mock-up and representative areas of required work, discuss and evaluate for compliance with Contract Documents, including substrate conditions, surface preparations, sequence of procedures, and other preparatory work performed by other installers.
    - b. Review Contract Document requirements.
    - c. Review approved submittals and field mock-up.
    - d. Review procedures, including, but not limited to:
      - 1) Applicable Division 03 Section on cast-in-place concrete
      - 2) Specific mix design.

- 3) Specified curing methods/procedures.
  - 4) Projected 3, 14, and 28 day compressive strength test for finished floor and project phasing.
  - 5) Protection of concrete substrate during construction and prior to polishing process.
  - 6) Project phasing and scheduling for each step of grinding, honing and polishing operations including, but not limited to:
    - (a) Quality of qualified personnel committed to project.
    - (b) Quality and size of grinders committed to project.
    - (c) Proper disposal of concrete slurry and/or concrete dust.
  - 7) Details of each step of grinding, honing, and polishing operations.
    - (a) Application of color.
    - (b) Application of liquid applied products.
    - (c) Protecting polished concrete floors after polishing work is complete.
  - 8) Reports: Record discussions, including decisions and agreements reached, and furnish copy of record to each party attending.
- B. Coordination: Coordinate selected polished concrete installation method and materials with concrete mix design. Concrete admixtures may effect the quality of the polished concrete installation.
1. Contractor to verify if the inclusion of any admixtures, plasticizers, slag, fly ash, or any other products replacing portions of the Portland cement will adversely effect the application and performance of the polished concrete system.
  2. Commerical Facilities Only: Polished concrete shall not be installed on floors with macro/micro synthetic reinforcement fibers.

#### 1.6 SUBMITTALS

- A. Product Data: For each grinding machine, including all types of grinding heads, dust extraction system, joint filler, concrete densifying impregnator, penetration sealer, and any other chemicals used in process.
- B. Concrete mix design for areas to receive polished concrete.
- C. Include surface preparation and installation instructions.
- D. Reference polished concrete samples, not less than 8 inches by 10 inches, for each polished concrete finish required.
- E. Sustainable Submittals:
  1. For liquid-applied flooring components, documentation including printed statement of VOC content Environmental Product Declaration.
- F. Maintenance Data:
  1. Include instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use.
  2. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.

- G. Safety data sheets (formally known as MSDS).
- H. Evaluation Service Reports (Lab testing for product performance): Show compliance with specified requirements with individual material sections. Including:
  - 1. Lab testing for slip resistance
  - 2. VOC content
  - 3. Abrasion resistance
  - 4. Impact strength
  - 5. Ultra violet stability
- I. Installer's Qualification Statement.
- J. Test Reports: As they are completed after installation.
  - 1. ASTM E303 Dry surface only.
  - 2. Floor Surface Profiles, ASTM E1155/ ASTM E1155M: Floor Flatness Number (FF).
  - 3. Floor Aggregate Clarity: ASTM D5767: % of Distinctness-of Image
  - 4. Floor Haze Index: ASTM D4039: clearly identity angle of illumination, refractive index of the material, and the geometric distribution of the reflected light for each measurement taken.

#### 1.7 QUALITY ASSURANCE

- A. All materials used shall be from same single source manufacturer.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience. Letters of certification from equipment manufacturer and manufacturer of penetrating sealer hardener verifying installer is certified as applicator of required finishing system. Installer/applicator shall provide adequate number of skilled workmen who are thoroughly trained and experienced in necessary craft.
- C. For all manufacturing locations, including administrative offices: the manufacturing shall provide certification that the silicate formulation proposes no risk of stray silicone molecules.
- D. Installed Performance Requirements: Improve performance of floor by installation of polished concrete floor system as measured by the following criteria:
  - 1. ASTM E303, British Pendulum Test: Minimum Pendulum Test Value (PTV) of 36 (dry), while targeting a mean PTV of 38 to 42.
  - 2. See 2.04 Materials and Product Requirements for the required pre-install lab testing for slip resistance.
- E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

#### 1.8 MOCK-UP

- A. Field Mock-up: Before performing work of this Section, provide following field mock-up to verify selections made under submittals and to demonstrate aesthetic effects of polishing. Approval does not constitute approval of deviations from Contract Documents, unless Architect specifically approves deviations in writing.
  - 1. Form, reinforce, and cast concrete slab for 10 foot square field mock-up.
  - 2. Concrete shall be same mix design as scheduled for Project.

3. Placement and finishing work shall be performed by same personnel as will place and finish concrete for Project.
4. Mock-up shall be representative of work to be expected.
5. Perform grinding, honing, and polishing work as scheduled for Project using same personnel as will perform work for Project.
6. Approval is for following aesthetic qualities:
  - a. Compliance with approved submittals.
  - b. Compliance with specified aggregate exposure class.
  - c. Compliance with specified appearance level.
7. Compliance with specified color, if color is indicated in project drawings.
8. Compliance with ASTM E303 and values given in 1.07 Quality Assurance.
- B. Obtain Architect's approval before starting work on Project.
- C. Protect and maintain approved field mock-ups during construction in an undisturbed condition as a standard for judging completed work.
- D. Mock-up may remain as part of the Work.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original containers, with seal's unbroken, bearing manufacturer labels indicating brand name and directions for storage.
- B. Dispense special concrete finish material from factory numbers and sealed containers. Maintain record of container numbers.

#### 1.10 FIELD CONDITIONS

- A. Damage and Stain Prevention: It is the responsibility of others to prevent damage and staining of concrete surfaces to be polished.
  1. Prohibit use of markers, spray paint, and soapstone.
  2. Prohibit improper application of liquid membrane film forming curing compounds.
  3. Prohibit vehicle parking over concrete surfaces.
  4. Prohibit pipe-cutting operations over concrete surfaces.
  5. Prohibit storage of any items over concrete surfaces for not less than 28 days after concrete placement.
  6. Prohibit ferrous metals storage over concrete surfaces.
  7. Protect from petroleum, oil, hydraulic fluid, or other liquid dripping from equipment working over concrete surfaces.
  8. Protect from acids and acidic detergents contacting concrete surfaces.
  9. Protect from painting activities over concrete surfaces.
- B. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting liquid applied product application.

#### 1.11 WARRANTY

- A. Submit for Owner's acceptance, manufacturer's standard 10 year Warranty document executed by authorized company official.

## PART 2 PRODUCTS

### 2.1 POLISHED CONCRETE SYSTEM VISUAL REQUIREMENTS

- A. Color: Natural unless indicated other wise in project drawings. If color is is selected, provide manufacture's standard color selections.
- B. Appearance Level: Flat, Ground, or Polished. Level indicated in project drawings.
- C. Depth of Grind: Cement fines, fine or course aggregate. Class indicated in project drawings.
- D. Exposed Aggregate: Coordinate with mix design
- E. Surface Sealer: penetrating solution of water based floropolymers that is invisible and provides moisture and stain protection.

### 2.2 MANUFACTURERS

- A. CureCrete; Springville, UT
- B. Dayton Superior; Dayton, OH
- C. Euclid Chemical Company; Cleveland, OH
- D. L&M Construction Chemicals; Bethany, CT
- E. Prosoco; Lawrence, KS
- F. Scofield Sika; Douglasville, GA
- G. Substitutions: See Section 01 25 00.

### 2.3 CONCRETE MIX:

- A. See 03 30 00 for mix design product requirements and approved products.
- B. Provide preapproved mix design for review by Architect prior to placement of concrete mockup.

### 2.4 LIQUID APPLIED PRODUCTS

- A. Siliconate Penetrating Liquid Floor Densifier: An aqueous solution of silicon dioxide dissolved in one of the following hydroxides that penetrates into the concrete surface and reacts with the calcium hydroxide to provide a permanent chemical reaction that hardens and densifies the wear surface of the cementitious portion of the concrete.
  - 1. Acceptable Chemistries: final polished concrete system to be selected based on project conditions and requirements.
    - a. Sodium Silicate
    - b. Potassium Silicate
    - c. Lithium Silicate
- B. Surface Sealer: penetrating solution of water based floropolymers that is invisible and provides moisture and stain protection.
- C. System Performance Requirements:
  - 1. Slip Resistance (Lab tested):
    - a. A value of 36 or greater for dry conditions per ASTM E303; or



- b. Classified as "high traction" by ANSI/NFSI B101.3; or
  - c. Bearing a UL 410 certification.
  - d. Laboratory slip resistance testing does not relieve the Contractor for the responsibility of delivering a final floor system compliant to the Owner's slip resistance requirement in the Quality Assurance and Field Quality Control sections of this specification.
2. VOC content: no more than minimum as set by SCAQMD 1113 or CARB (SCM)
  3. Abrasion Resistance: ASTM C779 / C779M - indicate % increase in abrasion resistance as compared to like concrete substrate, and quantitative were between 30 and 60 second of concrete with liquid densifier applied.
  4. Impact Strength: ASTM C805 / C805M- indicate % increase impact strength
  5. Ultra Violet Stability: ASTM G152 - No yellowing or degradation.

## 2.5 COLORED FINISH

- A. This section applies to slabs to receive tinting, consult project drawings for applicability.
- B. Acceptable Methods: final solution is to be based on project conditions and requirements.
  1. Acid Stain: Reactive solution of one or more metal salts stabilized by acid that produces coloration in a concrete substrate by neutralization of acid followed by precipitation of metal hydroxides or oxides.
  2. Shakes: See Section 03 30 00
- C. Performance Requirements:
  1. VOC content: no more than minimum as set by SCAQMD 1113 or CARB (SCM)

## 2.6 ACCESSORIES

- A. Repair Material: A product that is designed to repair cracks and surface imperfections. The specified material must have sufficient bonding capabilities to adhere after the polishing to the concrete surface and provide abrasion resistance equal to or greater than the surrounding concrete substrate.
- B. Neutralizing Agent: If required by manufacturer.
- C. Grout Material: A thin mortar used for filling spaces. Acceptable products shall be:
  1. Epoxy, urethane, polyurea, or polyaspartic resins.
  2. Latex or acrylic binders mixed with cement dust from previous grinding steps.
  3. Silicate binders mixed with cement dust from previous grinding steps.

## 2.7 POLISHING EQUIPMENT

- A. Field Grinding and Polishing Equipment:
  1. A multiple head, counter rotating, walk behind or ride on machine, of various size and weights, with diamond tooling affixed to the head for the purpose of grinding concrete. Excludes janitorial maintenance equipment.
  2. If dry grinding, honing, or polishing, use dust extraction equipment with flow rate suitable for dust generated, with squeegee attachments to meet OSHA requirements.
  3. If wet grinding, honing, or polishing, use slurry extraction equipment suitable for slurry removal and containment prior to proper disposal.

- B. Edge Grinding and Polishing Equipment: Hand-held or walk-behind machines which produces the same results, without noticeable differences, as field grinding and polishing equipment.
- C. Burnishing Equipment: High speed walk-behind or ride-on machines capable of generating 1000 to 2000 revolutions per minute and with sufficient head pressure of not less than 20 pounds to raise floor temperature by 20 degrees F.
- D. Diamond Tooling: Abrasive tools that contain industrial grade diamonds within a bonded matrix (such as metallic, resinous, ceramic, etc) that are attached to rotating heads to refine the concrete substrate.
  - 1. Bonded Abrasive: Abrasive medium that is held within a bonding that erodes away to expose new abrasive medium as it is used.
  - 2. Metal Bond Tooling: Diamond tooling that contains industrial grade diamonds with a metallic bonded matrix that is attached to rotating heads to refine the concrete substrate. These tools are available in levels of soft, medium, and hard metallic matrices that are matched with contrasting concrete substrates (i.e. hard matrix/soft concrete, medium matrix/medium concrete, soft matrix/hard concrete) and are typically used in the grinding and early honing stages of the polishing process.
  - 3. Resin Bond Tooling: Diamond tooling that contains industrial grade diamonds within a resinous bonded matrix (poly-phenolic, ester-phenolic, and thermoplastic-phenolic) that is attached to rotating heads to refine the concrete substrate. Resin bond tooling does not have the soft/medium/hard characteristics of metal bond tooling and are typically used for the later honing and polishing stages of the polishing process.
  - 4. Hybrid Tooling: Diamond tooling that combines metal bond and resin bond that has the characteristics of both types of tooling. These types of tools are typically used as either transitional tooling from metal bond tools to resin bond tools or as a first cut tool on smooth concrete surfaces.
  - 5. Transitional Tooling: Diamond tooling that is used to refine the scratch pattern of metal bond tooling prior to the application of resin bond tooling in an effort to extend the life of resin bond tooling and to create a better foundation for the polishing process.
  - 6. Abrasive Pad: An abrasive pad, resembling a typical floor maintenance burnishing pad that has the capability of refining the concrete surface on a microscopic level that may or may not contain industrial grade diamonds. These pads are typically used for the maintenance and/or restoration of previously installed polished concrete flooring.

### PART 3 EXECUTION

#### 3.1 EXISTING FLOOR APPLICATIONS

- A. Contractor to provide floor surface profile test in accordance to ASTM E1155 / ASTM E1155M, verify flatness acceptable to proposed product. Provide testing reports to the Owner and Polished Concrete System Installer.
- B. Installer to perform a test patch sanding of adequate size, to determine the existing slab's condition prior to beginning work. This test patch can become the required mock-up for Architect-Engineer 's approval.

#### 3.2 EXAMINATION

- A. Examine floor to receive polished concrete floor system.

- B. Notify Architect and Owner of conditions that would adversely affect installation or subsequent use.
- C. Do not begin surface preparation or installation until unacceptable conditions are corrected.
- D. Verify the Following for New Concrete Floors in accordance with ASTM E1155/ ASTM E1155M:
  - 1. Floor Finish: Bull-floated, smooth, pan-finished floor from edge to edge, with no rough areas.
  - 2. Floor and Joints:
    - a. Free of debris and excessive dirt, dust, clay, and mud.
    - b. Dry.
  - 3. Floor Surface Profile (Slab-on-ground):
    - a. Floor Flatness Number (FF): Overall FF 50, with a minimum local value of FF 35.50 (preferred).
    - b. Floor Levelness Number (FL): Overall FL 25, with a minimum local value of FL 17.
  - 4. Concrete Compressive Strength: 3,500 psi to 5,000 psi, consult product requirements for exact minimum compressive strength required.
  - 5. Concrete Curing: Consult specific system product data may require more time for required times and methods.
  - 6. Concrete Adjacent to Floor Penetrations: Troweled flat and level with surrounding concrete.

### 3.3 PREPARATION

- A. Protection: Protect surrounding areas and adjacent surfaces from the following:
  - 1. Minimal accumulation of dust from grinding and polishing.
- B. Clean Surfaces: Remove dirt, dust, debris, oil, grease, curing agents, bond breakers, paint, coatings, and other surface contaminants which could adversely affect installation of polished concrete floor system
- C. Surface Preparation: Prepare surfaces in accordance with installer's instructions. General Contractor shall correct conditions that are found to be out of compliance with the requirements of this section. Repairs are not acceptable unless specifically approved on a case-by-case basis by the Architect.
- D. Close areas to traffic during floor application and afterwards per manufacture's recommended time.

### 3.4 POLISHED CONCRETE FLOORS

- A. Perform all polishing procedures to ensure a consistent visual appearance from wall to wall.
- B. Initial Grinding:
  - 1. Use grinding equipment with metal or semi-metal bonded tooling.
  - 2. Begin grinding in one direction using sufficient size equipment and diamond tooling to meet specified aggregate exposure class.
  - 3. Make sequential passes with each pass perpendicular to previous pass using finer grit tool with each pass.

4. Achieve maximum refinement with each pass before proceeding to finer grit tools.
  5. Clean floor thoroughly after each pass using dust extraction equipment properly fitted with squeegee attachment or walk behind auto scrubber suitable to remove all visible loose debris and dust.
  6. Continue grinding until aggregate surface exposure matches approved field mock-up.
- C. Treating Surface Imperfections:
1. Mix patching compound or grout material with dust created by grinding operations, manufacturer's tint, or sand to match color of adjacent concrete surfaces.
  2. Fill surface imperfections including, but not limited to, holes, surface damage, small and micro cracks, air holes, pop-outs, and voids with grout to eliminate micro pitting in finished work.
  3. Work compound and treatment until color differences between concrete surface and filled surface imperfections, compared to mockup, are not reasonably noticeable when viewed from 20 feet away under lighting conditions that will be present after construction.
- D. Concrete Staining: Per manufacturer's requirements.
- E. Liquid Densifier Application: Apply undiluted flood coat to point of rejection, remove excess liquid, and allow curing according to manufacturer's instructions. Spraying methods must be approved by Owner.
- F. Grout Grinding:
1. Use grinding equipment and appropriate grit and bond diamond tooling.
  2. Apply grout, forced into the pore structure of the concrete substrate, to fill surface imperfections.
  3. Clean floor thoroughly after each pass using dust extraction equipment properly fitted with squeegee attachment or walk behind auto scrubber suitable to remove all visible loose debris and dust.
- G. Honing:
1. Use grinding equipment with hybrid or resin bonded tooling.
  2. Hone concrete in one direction starting with 100 grit tooling and make as many sequential passes as required to remove scratches, each pass perpendicular to previous pass, up to 400 grit tooling reaching maximum refinement with each pass before proceeding to finer grit tooling.
  3. Clean floor thoroughly after each pass using dust extraction equipment properly fitted with squeegee attachment or walk behind auto scrubber suitable to remove all visible loose debris and dust.
- H. Polishing
1. This section is application to applications requiring a specified finish appearance level of 3.
  2. Use polishing equipment with resin-bonded tooling.
  3. Begin polishing in one direction starting with 800 grit tooling.

4. Make sequential passes with each pass perpendicular to previous pass using finer grit tooling with each pass until the specified level of appearance has been achieved.
  5. Achieve maximum refinement with each pass before proceeding to finer grit pads.
  6. Clean floor thoroughly after each pass using dust extraction equipment properly fitted with squeegee attachment or walk behind auto scrubber suitable to remove all visible loose debris and dust.
  7. Final Polish: Using burnishing equipment and finest grit abrasive pads, burnish to uniform reflective sheen matching approved field mock-up.
- I. Stain Protection: Uniformly apply and remove excessive liquid according to manufacturer's instructions. Final film thickness should be less than .05 mils after cure.

3.5 COLORING CONCRETE FLOORS

- A. Consult project documents for applicability to project.
- B. Color to be selected from manufacture's standard colors.
- C. Acid Stain
  1. Follow manufacture's recommendation for installation
- D. Color Shake: See Section 03 30 00.

3.6 FINAL POLISHED CONCRETE FLOOR FINISH:

- A. Final finish as indicated in project drawings.
- B. Aggregate Exposure, as defined by Concrete Polishing Association of American

Class	Name	Approximate Surface Cut Depth	Appearance
A	Cream	Very Little	Little aggregate exposure
B	Fine aggregate (salt and pepper finish)	1/16 inch	Fine aggregate exposure with little or no medium aggregate at random locations
C	Medium aggregate	1/8 inch	Medium aggregate exposure with little or no large aggregate exposure at random locations
D	Large aggregate	1/4 inch	Large aggregate with little or no fine aggregate exposure

- C. Final Appearance Level, as defined by the Concrete Polishing Council
  1. Appearance level as indicated in project drawings.
  2. Appearance Level 1 - Flat (Ground): Up to 400 grit polish.
    - a. Procedure: Recommended not less than 4 step process with full refinement of each diamond tool with one application of densifier.
    - b. Measurement: Determine the Image Clarity Value, %, and the Haze Index:
      - 1) Image Clarity Value, %: An average value of 9 or less measured in accordance with ASTM D5767 prior to the application of sealers.
      - (a) Haze Index: An average value less than 10 measured in accordance with ASTM D4039 prior to the application of sealers.

- (b) The minimum number of tests distributed across the polished surface should be three, for areas up to 1000 ft<sup>2</sup> and one additional test for each 1000 ft<sup>2</sup> or fraction thereof. This applies to both the Image Clarity Value and Haze Index.
- 3. Appearance Level 2 - Satin (Honed): Up to 800 grit polish.
  - a. Procedure: Recommended not less than 4 step process with full refinement of each diamond tool with one application of densifier.
  - b. Measurement: Determine the Image Clarity Value,%, and the Haze Index:
    - 1) Image Clarity Value, %: An average value of 10 to 39 measured in accordance with ASTM D5767 prior to the application of sealers.
    - 2) Haze Index: An average value less than 10 measured in accordance with ASTM D4039 prior to the application of sealers.
    - 3) The minimum number of tests distributed across the polished surface should be three, for areas up to 1000 ft<sup>2</sup> and one additional test for each 1000 ft<sup>2</sup> or fraction thereof. This applies to both the Image Clarity Value and Haze Index.
- 4. Appearance Level 3 - Polished: Up to 1500 grit polish. Do not use for Ford facilities unless mock-up can meet ASTM E303 without acrylic sealers. Acrylic sealers require regular recoating and may not acceptable due to maintenance concerns.
  - a. Procedure: Recommended not less than 4 steps with full refinement of each diamond tool with one application of densifier.
  - b. Measurement: Determine the Image Clarity Value,%, and the Haze Index:
    - 1) Image Clarity Value, %: An average value of 40 to 69 measured in accordance with ASTM D5767 prior to the application of sealers.
      - (a) Haze Index: An average value less than 10 measured in accordance with ASTM D4039 prior to the application of sealers.
      - (b) The minimum number of tests distributed across the polished surface should be three, for areas up to 1000 ft<sup>2</sup> and one additional test for each 1000 ft<sup>2</sup> or fraction thereof. This applies to both the Image Clarity Value and Haze Index.
- 5. Appearance Level 4 -Highly Polished: Up to a 3000 grit polish. Do not use for Ford facilities unless mock-up can meet ASTM E303 without acrylic sealers. Acrylic sealers require regular recoating and may not acceptable due to maintenance concerns.

### 3.7 FIELD QUALITY CONTROL

- A. Inspect completed polished concrete floor system with Architect, Contractor, and Installer.
- B. Review procedures with Architect to correct unacceptable areas of completed polished concrete floor system.
- C. Testing: Test the following from completed polished concrete floor system:
  - 1. ASTM E303 For coefficient of friction, dry surface only.
  - 2. Floor Surface Profiles, ASTM E1155/ ASTM E1155M: Floor Flatness Number (FF).
  - 3. Floor Aggregate Clarity: ASTM D5767: % of Distinctness-of Image

4. Floor Haze Index: ASTM D4039: clearly identify angle of illumination, refractive index of the material, and the geometric distribution of the reflected light for each measurement taken.

D. Test Results:

1. Report test results in writing to Owner, Architect, and Contractor within 24 hours after tests.
2. Compare test results from tests performed after installation of polished concrete floor system.

### 3.8 CLEANING

- A. Clean and protect concrete slab, scheduled to receive polished concrete flooring finish, immediately after concrete curing, prior to concrete polishing, and between polishing phases while subsequent construction occurs and after completion of polishing until acceptance by the Owner.
- B. Spills shall be cleaned up immediately.
  1. Provide protection from rain or other moisture that may migrate or pass through uncompleted construction such as roof openings or exterior wall penetrations.
  2. Splatters of mortar, paint or similar construction materials shall be immediately cleaned- up.
  3. Spilled liquids shall be immediately cleaned-up.
- C. Cleaning: Clean at least once every evening after Work in the area of polished floors are done for the workday.
  1. No chemicals, detergents or other products may be added to cleaning machine; only potable water is to be used.
  2. Continuously change water in the scrubber. Dirty water from scrubber left on polished surfaces will etch finished surface.
- D. Clean finished polished concrete flooring using a walk behind power floor scrubber with squeegee and soft brush.
  1. Brushes: Use one of the following as appropriate:
    - a. Nylon softens when wet, so it is used for gentle scrubbing, mopping or polishing of decorative floors.
    - b. Bassine natural fiber which is traditional material used for gentle scrubbing.
    - c. Union mix combination of bassine and another natural fiber called tampico, used for light scrubbing or buffing.

### 3.9 CLOSEOUT ACTIVITIES

- A. Training: Train Owner's personnel on operation and maintenance of system.
  1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  2. Instructor: Manufacturer's training personnel.
  3. Location: At project site.

3.10 PROTECTION

- A. Protect installed polished floor from subsequent construction operations. Follow manufactures recommendations for protection.
- B. Do not permit traffic over the polished floor.

END OF SECTION 033543



## SECTION 079200 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 ISSUES

1. It the intent that all joint sealants used on its projects will comply with LEED™ NC 3 Credit Requirements EQ Credit 4.1: Low-Emitting Materials: Adhesives and Sealants.

#### 1.2 SUMMARY

- A. This Section includes joint sealants for the applications listed in 3.6 JOINT SEALANT SCHEDULE below, and including those specified by reference to this Section:
- B. Related Sections include the following:
  1. Division 08 Section GLAZING for glazing sealants.
  2. Division 09 Section CERAMIC TILING for sealing tile joints.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

#### 1.4 SUBMITTALS

- A. VOC Statement and Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- D. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.
- E. Qualification Data: For Installer and testing agency.
- F. Preconstruction Field Test Reports: When requested by owner, indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.
- G. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
  1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

- H. Field Test Report Log: For each elastomeric sealant application.
- I. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.
- J. Warranties: Submit written special warranty as specified in this Section. Include contact information, description of coverage, and start date for each special warranty

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
  - 1. Use ASTM C 1087 or manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  - 2. Submit not fewer than six pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
  - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
  - 5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the commencement of the Work.
  - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
  - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
  - 3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
  - 4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
- E. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:
  - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
  - 2. Conduct field tests for each application indicated below:
    - a. Each type of elastomeric sealant and joint substrate indicated.

- b. Each type of nonelastomeric sealant and joint substrate indicated.
3. Notify Project Manager seven days in advance of dates and times when test joints will be erected.
    - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.
      - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  4. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
  5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

#### 1.6 PROJECT CONDITIONS

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

#### 1.7 WARRANTY

- A. Special Warranty
  1. Provide installation warranty for a period of 5 years against defective materials and workmanship.
  2. During the warranty period restore defective work to the standard of the contract documents without additional compensation, including all materials, labor, refinishing and other costs incidental to the work. Within 24 hours after receipt of notice from the owner, inspect the work and immediately repair leaks. Restore work found to be defective as defined in the contract documents, within 10 days after receipt of notice from the owner.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

### 2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

### 2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Single-Component Neutral-Curing Silicone Sealant; **SEALANT A**

1. Available Products:

- a. Dow; DOWSIL 790 Silicone Building Sealant.
- b. GE Silicones; SilPruf SCS2000.
- c. Dow; DOWSIL 791 Silicone Weatherproofing Sealant.
- d. Dow; DOWSIL 795 Silicone Building Sealant.
- e. Pecora Corporation; 895.
- f. Dow; DOWSIL 756 SMS Building Sealant.
- g. Or as approved

2. Type and Grade: S (single component) and NS (nonsag).

3. Class: 50.

4. Use Related to Exposure: NT (nontraffic).

5. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

- F. Multicomponent Immersible Urethane Sealant **SEALANT B**

1. Available Products:
  - a. LymTal International, Inc., Iso-Flex 881 (NS – nonsag)
  - b. LymTal International, Inc., Iso-Flex 880 (P – pourable).
  - c. Or as approved
2. Type and Grade: M (multicomponent) and NS (nonsag) or P (pourable).
3. Class: 25.
4. Uses Related to Exposure: T (traffic), NT (nontraffic) and I (immersible).

G. Single-Component Mildew-Resistant Acid-Curing Silicone Sealant **SEALANT C.**:

1. Available Products:
  - a. Dow; DOWSIL 786 Silicone Sealant - M
  - b. GE Silicones; Sanitary SCS1700.
  - c. Tremco; Tremsil 200.
  - d. Or as approved
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).

2.4 LATEX JOINT SEALANTS

- A. Latex Sealant: Comply with ASTM C 834 **SEALANT D.**
- B. Available Products:
  1. DAP DYNAFLEX 230.
  2. Pecora Corporation; AC-20+Silicone.
  3. Or as approved.

2.5 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Concealed Joints: Manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission. **SEALANT E.**
  1. Available Products:
    - a. Pecora Corporation; BA-98.
    - b. Tremco; Tremco Acoustical Sealant.
    - c. Or as approved.

2.6 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) O (open-cell material) or B (bicellular material with a surface skin), as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## 2.7 MISCELLANEOUS MATERIALS

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, 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 surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
  - a. Metal.
  - b. Glass.
  - c. Porcelain enamel.
  - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- D. 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.
- E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- F. 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.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess 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 configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

### 3.4 CLEANING

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

### 3.5 PROTECTION

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

### 3.6 JOINT-SEALANT SCHEDULE

- A. **SEALANT A**: Control joints in interior and exterior (non-traffic) masonry. Joints in interior and exterior precast architectural concrete. Joints between interior masonry non-bearing walls or partitions and under side of floors, beams and slabs. Joints around pipes, conduits, and ducts that penetrate walls and partitions. Exterior joints at perimeter of metal frames, including door and window frames. Exterior joints at ends of aluminum windowsills. Horizontal (non-traffic) and vertical expansion joints in exterior brick masonry.
- B. **SEALANT B**: Isolation and control joints in exposed interior concrete floors. Expansion joints in interior tile. Expansion and control joints in exterior curbs and walks, and in paving other than concrete road paving, subject to pedestrian and vehicular traffic.
- C. **SEALANT C**: Perimeter of toilet fixtures, vanities, kitchen counters, interior non-traffic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
- D. **SEALANT D**: Interior joints at the perimeter of hollow metal doorframes (except at the face of hollow metal frames adjoining walls finished with wall tile, which will have grout tight to the door frames.)
- E. **SEALANT E**: Use as specified in SECTION 092613 GYPSUM VENEER PLASTER and SECTION 095113 ACOUSTICAL PANEL CEILINGS.



END OF SECTION 079200

## SECTION 081113 – HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 ISSUES

- A. Use steel doors and frames for openings subject to repeated impact or abuse, or when appropriate to achieve required fire resistance rating
- B. Steel framing is the standard for all interior doorways, paired with flush wood doors. (See Division 8 section 081416 FLUSH WOOD DOORS), and for interior windows.
- C. When used on exterior openings, steel doors and frames shall be galvanized.
- D. All public and personnel doors shall be a minimum of 36" wide to provide barrier free access for mobility aid users.
- E. All public and personnel doorway thresholds shall meet the latest ICC/ANSI A117.1 standards to provide barrier free access for mobility and physically impaired users.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Standard hollow-metal steel doors.
  - 2. Standard hollow-metal steel frames.
- B. Related Sections include the following:
  - 1. Division 07 Section JOINT SEALANTS for sealants used in hollow metal frame installation.
  - 2. Division 08 Section GLAZING for glazed lites in standard steel doors.
  - 3. Division 08 Section HARDWARE for door hardware for standard steel doors.
  - 4. Division 09 Section INTERIOR PAINTING for field painting standard steel doors and frames.

#### 1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.

#### 1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire resistance rating and finishes for each type of steel door and frame specified.
- B. Oversize Construction Certification: For standard steel door assemblies required to be fire rated and exceeding limitations of labeled assemblies; include statement that doors comply with requirements of design, materials, and construction but have not been subjected to fire test.

- C. Qualification Data: For Installer.
- D. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of standard steel door and frame.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.
- C. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.
- D. Fire-Rated Door Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  - 1. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
  - 1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

#### 1.7 COORDINATION

- A. Coordinate installation of anchorages for standard steel frames. 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.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Amweld Building Products, LLC.
  2. Ceco Door Products; an ASSA ABLOY Group Company.
  3. CURRIES Company; an ASSA ABLOY Group Company.
  4. Fleming Door Products Ltd.; an ASSA ABLOY Group Company.
  5. Pioneer Industries, Inc.
  6. Republic Doors and Frames; a Windsor Republic Door Company
  7. Steelcraft; an Ingersoll-Rand Company.

### 2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 zinc-iron-alloy (galvannealed) coating designation.
- D. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.
- F. Powder-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 standard steel door frames of type indicated.
- G. Grout: Comply with ASTM C 476, with a slump of 4 inches for standard steel door frames built into concrete or masonry, as measured according to ASTM C 143/C 143M.
- H. Glazing: Comply with requirements in Division 8 Section "Glazing."
- I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

### 2.3 STANDARD STEEL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.

1. Design: Flush panel.
  2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.
    - a. Fire Door Core: As required to provide fire-protection ratings indicated.
  3. Vertical Edges for Single-Acting Doors: Beveled edge.
    - a. Beveled Edge: 1/8 inch in 2 inches.
  4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick end closures or channels of same material as face sheets.
  5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2-Seamless for standard size doors not subject to heavy abuse.
  2. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2-(Seamless) for large doors (greater than 48") or doors subject to heavy abuse.
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior door requirements. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless) for standard size doors not subject to heavy abuse.
  2. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless) for large doors (greater than 48") or doors subject to heavy abuse.
- D. Hardware Reinforcement: Fabricate reinforcement plates from same material as door face sheets to comply with the following minimum sizes:
1. Hinges: Minimum 0.123 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
  2. Lock Face Closers, and Concealed Holders: Minimum 0.067 inch thick.
  3. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.
- 2.4 STANDARD STEEL FRAMES
- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
1. Fabricate frames with mitered or coped and welded face corners.
  2. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.

3. Frames for Level 3 Steel Doors: 0.067-inch- thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
1. Fabricate frames with mitered or coped and welded face corners.
  2. Frames for Level 2 Steel Doors and for flush wood doors 0.053-inch- thick steel sheet.
  3. Frames for Level 3 Steel Doors: 0.067-inch-thick steel sheet.
- D. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:
1. Hinges: Minimum 0.123 inches thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
  2. Lock Face Closers, and Concealed Holders: Minimum 0.067 inch thick.
  3. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick.
- E. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.
- F. Jamb Anchors:
1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
  2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
  3. Post installed Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- G. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
  2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.
- H. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.
- 2.5 STOPS AND MOLDINGS
- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch high, unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

## 2.6 FABRICATION

- A. General: Fabricate standard steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Standard Steel Doors:
1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
  2. Glazed Lites: Factory cut openings in doors.
- C. Standard Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
  2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
  3. Plaster Guards: Weld guards to frame at back of hardware mortises in frames installed in concrete, masonry or plastered walls.
  4. Where installed in masonry, leave vertical mullions in frames open at top for grouting.
  5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  6. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Two anchors per jamb up to 60 inches in height.
      - 2) Three anchors per jamb from 60 to 90 inches in height.
      - 3) Four anchors per jamb from 90 to 120 inches in height.
      - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 120 inches in height.
    - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Three anchors per jamb up to 60 inches in height.
      - 2) Four anchors per jamb from 60 to 90 inches in height.
      - 3) Five anchors per jamb from 90 to 96 inches in height.
      - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof more than 96 inches in height.
      - 5) Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
    - c. Compression Type: Not less than two anchors in each jamb.
    - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to 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.
- D. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section DOOR HARDWARE.
  1. Reinforce doors and frames to receive non-templated mortised and surface-mounted door hardware.
  2. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.
- E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
  1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of door or frame.
  2. Multiple Glazed Lites: Provide fixed and removable stops and moldings such that each glazed lite is capable of being removed independently.
  3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  4. Provide loose stops and moldings on inside of doors and frames.
  5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

## 2.7 STEEL FINISHES

- F. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  1. Finish standard steel door and frames after assembly.
- G. Metallic-Coated Steel Surface Preparation: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
  1. Galvanizing Repair Paint: High-zinc-dust-content paint for reglazing welds in steel, complying with SSPC-Paint 20.
- H. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- I. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.



1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of standard steel doors and frames.
  1. Examine roughing-in for embedded and built-in anchors to verify actual locations of standard steel frame connections before frame installation.
  2. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- B. Remove welded-in shipping spreaders installed at factory.
- C. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
  1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- D. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

#### 3.3 INSTALLATION

- E. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install standard steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- F. Standard Steel Frames: Install standard steel frames for doors and other openings, of size and profile indicated. Comply with SDI 105.
  1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-protection-rated openings, install frames according to NFPA 80.
    - b. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.

- c. Install frames with removable glazing stops located on secure side of opening.
    - d. Install door silencers in frames before grouting.
    - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - f. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - g. Apply bituminous coating to backs of all exterior frames and those that are filled with mortar, grout, and plaster containing anti freezing agents.
  2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 4 Section "Unit Masonry Assemblies."
  4. Concrete Walls: Solidly fill space between frames and concrete with grout. Install grout in lifts and take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
  5. 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.
  6. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  7. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
  8. Installation Tolerances: Adjust standard steel door frames for squareness, alignment, twist, and plumb 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.
- G. Standard Steel Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
  1. Non-Fire-Rated Standard Steel Doors:
    - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
  2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

- H. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with standard steel door and frame manufacturer's written instructions.
  - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

#### 3.4 ADJUSTING AND CLEANING

- I. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.
- J. Clean grout and other bonding material off standard steel doors and frames immediately after installation.
- K. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
- L. Galvanized Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

## SECTION 081416 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 ISSUES

- A. Transparent finished wood doors and steel frames are the standard interior doors.
- B. All public and personnel doors shall be a minimum of 36" wide to provide barrier-free access for mobility aid users.
- C. It the intent that all flush wood doors used on its projects will comply with LEED™ NC 3 Credit Requirements MR Credit 4: Recycled Content, 10% (post-consumer + ½ pre-consumer), MR Credit 4: Recycled Content 20% (post-consumer + ½ pre-consumer), and EQ Credit 4.2 Low-Emitting Materials: Paints and Coatings. EQ Credit 4.2 will apply only in the instance of field finished doors.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Solid-core doors with wood-veneer faces.
  - 2. Factory finishing flush wood doors.
  - 3. Factory fitting flush wood doors to frames and factory machining for hardware.
  - 4. Louvers for flush wood doors.
- B. Related Sections include the following:
  - 1. Division 08 Section GLAZING for glass view panels in flush wood doors.
  - 2. Division 08 Section DOOR HARDWARE for hardware for flush wood doors.
  - 3. Division 08 Section HOLLOW METAL DOORS AND FRAMES for steel frames for flush wood doors.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of door, include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.
- B. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:
  - 1. Faces of Factory-Finished Doors: Show the full range of colors available for stained finishes.
- C. Samples for Verification:
  - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edgings representing typical range of color and grain for each species of veneer and solid lumber required. Finish sample with same materials proposed for factory-finished doors.
  3. Louver blade and frame sections, 6 inches long, for each material and finish specified.
  4. Frames for light openings, 6 inches long, for each material, type, and finish required.
- D. Submit printed statement and product data for field applied finishes in accordance with the General Administrative Requirements of the Construction Standards 01300.1.2. Maximum VOC content when calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1113, Architectural Coatings:
1. Clear Wood Finishes: Varnish Maximum 350 g/l, Lacquer Maximum 550 g/l
  2. Stains: Maximum 250 g/l
  3. Sealers: Waterproofing 250 g/l
  4. Sanding Sealers 275 g/l
  5. All Other Sealers 200 g/l
- E. Quality Assurance: Provide documentation as described in this section.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.
- B. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
  1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 or UBC Standard 7-2, whichever is most stringent.
  1. Oversize, Fire-Rated Wood Doors: For door assemblies exceeding sizes of tested assemblies, provide oversize fire door label or certificate of inspection, from a testing and inspecting agency acceptable to authorities having jurisdiction, stating that doors comply with requirements of design, materials, and construction.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with Project Number and opening number used on Shop Drawings.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flush Wood Doors:
  - a. Algoma Hardwoods Inc.
  - b. Eggers Industries; Architectural Door Division.
  - c. GRAHAM Manufacturing Corp.
  - d. Marshfield DoorSystems.
  - e. Mohawk Flush Doors, Inc.
  - f. Oshkosh Architectural Door Co.
  - g. VT Industries Inc.
2. Metal Louvers for Doors:
  - a. Air Louvers, Inc.
  - b. Anemostat Door Products.

### 2.2 DOOR CONSTRUCTION, GENERAL

- A. Doors for Transparent Finish:
1. Grade: Premium, with Grade AA faces.

### 2.3 SOLID-CORE DOORS

- A. Interior Veneer-Faced Doors:
1. Core: Glued block or structural composite lumber.
  2. Construction: Five or seven plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.
- B. Fire-Rated Doors:
1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
  2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as follows:
    - a. 5-inch top-rail blocking.
    - b. 5-inch bottom-rail blocking.
    - c. 5-inch midrail blocking, in doors indicated to have exit devices.
    - d. Blocking including stile of 4 ½ inch minimum net thickness on the latch side of the door.
    - e. Stile of 1 ¼ inch minimum net thickness after trimming on the hinge side of the door.

3. Pairs: Furnish formed-steel edges and astragals for pairs of fire-rated doors, unless otherwise indicated.
  - a. Finish steel edges and astragals to match door hardware locksets or exit devices.

#### 2.4 LOUVERS AND LIGHT FRAMES

- A. Wood Louvers: Door manufacturer's standard solid-wood louvers, unless otherwise indicated.
- B. Metal Louvers:
  1. Blade Type: Vision-proof, inverted V.
  2. Metal and Finish: Extruded aluminum with Class II, clear anodic finish complying with AA-C22A31.
- C. Wood Beads for Light Openings in Wood Doors:
  1. Wood Species: Species compatible with door faces.
  2. Profile: Flush rectangular beads.
  3. At 20-minute, fire-rated, wood-core doors, provide wood beads and metal glazing clips approved for such use.

#### 2.5 FABRICATION

- A. Fabricate doors in sizes indicated for Project-site fitting.
- B. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
  1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.
- C. Factory machine doors for hardware that is not surface applied.
  1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
  2. Metal Astragals: Premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- D. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
  1. Fabricate door and transom panels with full-width, solid-lumber meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal doorframes.
- E. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
  1. Light Openings: Trim openings with moldings of material and profile indicated.
  2. Louvers: Factory install louvers in prepared openings.

## 2.6 FACTORY FINISHING

- A. General: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated" for factory finishing.
- B. Transparent Finish:
  - 1. Grade: Premium.
  - 2. Finish: AWI System TR-4 Conversion Varnish.
  - 3. Sheen: Satin.

## EXECUTION

### 2.7 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
  - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 2.8 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
  - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
  - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold.
    - a. Comply with NFPA 80 for fire-rated doors.
  - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
  - 3. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.



F. Field-Finished Doors: Refer to the following for finishing requirements:

1. Division 09 Sections EXTERIOR PAINTING and INTERIOR PAINTING

2.9 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

## SECTION 087100 - DOOR HARDWARE

### PART 1 - GENERAL

#### 1.1 ISSUES

- A. On interior doors, do not install lights that extend below the level of the top of the mounting of the exit device or the lockset.
- B. Door stops on aluminum doors should be large enough to mount strikes or electric strikes and it is preferred that they be solid. Blade stops are not permitted.
- C. At the end of a project, all unused door hardware should be provided to the Key Shop.
- D. When appropriate, wall magnet door holders should be provided to hold doors open during heavy usage periods to save unnecessary wear on the mechanism.
- E. Hinges on all doors that open outward (reverse bevel) shall have NRP (Non-Removable Pin) hinges.
- F. A door closer is required on all doors in new or renovated computer labs (or similar spaces) which are not served by building central air conditioning and have window or room air conditioning equipment if the doors connect to non-air-conditioned spaces.
- G. All public and personnel doorway hardware shall meet the latest A.D.A. - ICC/ANSI A117.1 standards to provide barrier free access for mobility and physically impaired users.
- H. Where card access controls are provided, electrified locksets or electrified panic bars shall be used instead of electric strikes. The electrified hardware shall include an RX (Request to Exit) switch.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Commercial door hardware for the following:
    - a. Swinging doors.
    - b. Other doors to the extent indicated.
- B. Related Sections include the following:
  - 1. Division 08 Section HOLLOW METAL DOORS AND FRAMES for astragals provided as part of a fire-rated labeled assembly and for door silencers provided as part of the frame.
  - 2. Division 08 Section FLUSH WOOD DOORS for astragals provided as part of a fire-rated labeled assembly.
  - 3. Division 08 Section ACCESS DOORS for access door hardware, except cylinders.
  - 4. Division 08 Section ALUMINUM ENTRANCES AND STOREFRONTS for entrance door hardware, except cylinders.

5. Division 08 Section AUTOMATIC ENTRANCES for entrance door hardware, except cylinders.

- C. The following list is provided as a reference to clearly identify manufacturers cited in this standard:

1. Arrow Arrow Architectural Hardware; an ASSA ABLOY Group company
2. Baldwin Baldwin Hardware Corporation
3. Best Best Access Systems, Division of The Stanley Works
4. Corbin Russwin Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company
5. Glynn-Johnson Glynn-Johnson; an Ingersoll-Rand Company
6. Hager Hager Companies
7. Ives Ives; an Ingersoll-Rand Company
8. LCN LCN Closers; an Ingersoll-Rand Company
9. McKinney McKinney Products Company; an ASSA ABLOY Group company
10. Pemko Pemko Manufacturing Co., Inc.; an ASSA ABLOY Group company
11. Reese Reese Enterprises, Inc.
12. Rockwood Rockwood Manufacturing Company; an ASSA ABLOY Group company
13. Sargent Sargent Manufacturing Company; an ASSA ABLOY Group company
14. National Guard National Guard Products, Inc.
15. Von Duprin Von Duprin; an Ingersoll-Rand Company

### 1.3 SUBMITTALS

- A. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.
    - a. Organize door hardware sets in same order as in the Door Hardware Schedule at the end of Part 3.
  3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    - e. Explanation of abbreviations, symbols, and codes contained in schedule.
    - f. Mounting locations for door hardware.
    - g. Door and frame sizes and materials.

#### 1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with provisions of the following:
  - 1. Michigan Department of Labor, Bureau of Construction Codes and Fire Safety.
  - 2. Michigan State Police Fire Marshal Division.
    - a. Hardware furnished for labeled openings shall be labeled and have been tested by a testing laboratory recognized by the Michigan State Police Fire Marshal Division.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Each item of hardware shall be individually wrapped and packaged to avoid scratching or marking of the finishes.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

#### 1.6 COORDINATION

- A. Coordinate layout and installation of recessed pivots and closers with floor construction. Anchoring inserts shall be cast into concrete.
- B. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

#### 1.7 CYLINDERS AND KEYING

- A. All locking devices shall be supplied prepared for seven pin cylinders manufactured by Best Lock Corporation.
- B. All existing cylinders and cores will be salvaged to the Key Shop, unless otherwise directed.
- C. All cylinders, cores, and keys, temporary and permanent, shall be furnished by the Key Shop, which shall also perform the following:
  - 1. Remove existing cores and install construction cores on **existing doors** as required.
  - 2. Furnish construction cylinders, cores, and keys for **new doors**.
    - a. The contractor shall supply the Project Representative with a copy of the project Hardware Schedule to allow the Key Shop to match cylinders to the new hardware.
    - b. The contractor shall pick up cylinders, cores, and keys from the Key shop with the form "Authorization for Construction Cylinders, Cores, and Keys", completed and authorized by the Project Representative.
    - c. The contractor shall install construction cylinders in new doors for alignment of hardware, for use during construction, and for inspection of operation.
    - d. All construction keys issued to a contractor for a particular project will be returned to the Key Shop before final payment will be granted. Lost keys are subject to

finer consisting of the cost of re-keying all locks on campus, which have the same code as the lost key.

- e. The contractor shall tag and supply to the Key shop one copy of the key for each non-standard lock installed.

1.8 SCHEDULED DOOR HARDWARE

A. Hinges

- 1. Hinge locations shall conform to the National Builders Hardware Association Standards. avoids pivot hinges because they collect dirt and salt.
- 2. On relatively new installations and when existing conditions warrant, salvage existing hinges, clean, lubricate, and reinstall.
- 3. Electric hinges shall not be permitted.

**HINGE SCHEDULE**

<b><u>Typical Usage</u></b>	<b><u>Quantity</u></b>	<b><u>Style</u></b>	<b><u>Manufacturer</u></b>
Classrooms, offices, toilet rooms and storerooms of average size	1 1/2 pair	Full mortise 4 1/2" X 4 1/2" ball bearing, standard weight, butt hinges with non-rising removable pins	McKinney Hager BB1279 or approved equal
Low to medium frequency use entrances and toilet rooms, and stairwell doors of high frequency use.	1 1/2 pair	Full mortise 5" x 4 1/2" ball bearing heavyweight butt hinges with non-rising removable pins	Hager BB1168 McKinney T4B3786 or approved equal
Heavy doors, abused doors, or high frequency doors. Also for dormitory and stairwell doors when replacing frames.	One set, which includes one anchor and one pair butts	Full mortise 5" X 4 1/2" ball bearing, heavyweight, anchor-type hinges with non-rising removable pins, of required hand	Hager AB8505 McKinney or approved equal
New frames for openings with heavy weight and/or large cart traffic. Field check height of existing hinge gains when retrofitting.	1 1/2 pair	5" ball bearing, heavyweight, clearance hinges with non-rising removable pins	Hager BB1267 or approved equal
Existing frames for openings with medium weight cart traffic. Field check height of existing hinge gains when retrofitting.	1 1/2 pair	4 1/2 inch clearance hinges, TA-TB2895 x NRP	McKinney
These may be used only on existing doorframes when none of the above alternatives are appropriate, and only with the prior approval of the Key Shop.		780-210HD (surface mount) 780-224HD (mortise mount)	Hager-Roton

B. Lock and Latch Sets – Full Mortise

1. The quality of each mortise lock set assembly, including cylinder and escutcheon, must be Grade 1 for both operation and security in accordance with ANSI A156.13 and the latest BHMA "Directory of Certified Locks and Latches."
2. The lock set must accept Best interchangeable 7-pin tumbler cores and cylinders.
3. Locksets shall be full-mortise Corbin Russwin ML 2000 Series, with functions as listed in the lock and latch set schedule below. Knob and trim style shall be Corbin Russwin YWN trim, unless specified otherwise. Lever handle and trim style shall be Corbin Russwin NSN. Locksets shall have screwless shank and 2-<sup>3</sup>/<sub>4</sub> inch basket.
4. Provide curved lip strike plate with tongue of appropriate length for type of door trim used.
5. Locksets on doors with card access controls shall be Sargent 8271-RX in either the WTL or LWIL trim style. All electrified locksets shall be 24 VDC.

**LOCK AND LATCH SET SCHEDULE**

Typical Usage	Lock set
Use only in relatively new existing installations. Field check condition of existing locksets.	Salvage existing – clean lubricate, and reinstall.
Card access control door	Sargent 8271-RX-NSN
Classrooms, laboratories, teaching laboratories, and outside entrances with lock	Corbin Russwin ML2055
Offices	Corbin Russwin ML2051
Closets or passages	Corbin Russwin ML2010
Janitor closets and storage rooms	Corbin Russwin ML2057
Doors to roof, and from penthouse to roof two floors or less above grade and all air plenums.	Corbin Russwin ML2022, keyed both sides with abrasive knob inside
Mechanical rooms, transformer rooms, steam service tunnel access, telephone closets, and from public building space to roof, three floors or more above grade. Key Shop will modify lockset for lock cylinder and rigid knobs both sides when used from public space to roof below the third floor.	Corbin Russwin ML2057-M21, all with abrasive knob outside and free knob inside.
Penthouse to roof access, three floors or more above grade.	Corbin Russwin ML2057, all with abrasive knob outside and free knob inside.

Residence hall rooms	Corbin Russwin ML2065 YW Knob
Residence hall stairwells	Corbin Russwin ML2010
Toilet room with single stool, and barrier-free dormitory rooms.	Corbin Russwin ML2065
Barrier-free offices, used only on special request	Corbin Russwin ML2051
Loading dock floors with heavy cart traffic	Rockwood trim protector bar R111LPB

C. Exit Devices

1. Exit devices shall be rim-mounted and reversible with functions and options as listed below. Devices shall be mounted with panic bar at 37 inches above the floor with the devices undogged, or at the nearest approved manufacturer's standard.
2. **Concealed vertical rod shall not be used.**
3. Use Rockwood push plate's 70B series with all doggable exit devices.
4. All doors with card access controls shall be Von Duprin 98 Series exit devices

**EXIT DEVICES SCHEDULE**

<b><u>Typical Usage</u></b>	<b><u>Exit Device</u></b>
Use only for relatively new existing installations. Field check condition of existing.	Salvage existing, clean lubricate and reinstall.
Rated or stairwell opening with card access control	Von Duprin RX98F with E996L Electrified Lever Trim
Stairwell with no lock and that cannot be dogged down	Arrow FS3808 x SL08A Von Duprin 98L-F-BE Sargent 19-12-8815 x ETL
Stairwell with lock, or entrance in labeled opening where device cannot be dogged down during the day	Arrow FS3808 x SL08 Von Duprin 98L-F Sargent 19-12-8813 x ETL
Entrance door with card access control and key override	Von Duprin RX 98 NL QEL+

Entrance door with card access control and no key override	Von Duprin RX 98 DT QEL+
Entrance with dogging and outside pull trim	Arrow FS3803 x SP02 Von Duprin 98DL Sargent 19-8810 x PTB
Entrance with dogging, outside pull trim and keyed cylinder	Arrow FS3803 x SL03 Von Duprin 98NL Sargent 19-12-8804 x PTB
Fire escapes or low occupancy classrooms with exit only requirements	Arrow FS3803 Von Duprin 98EO-F Sargent 19-12-8810
Locations requiring controlled egress.	VonDuprin CHEXIT Series CX98 controlled exit device.
Residence hall wide stile entrance/exit doors with dogging and without cylinder	Von Duprin 98DT (pull trim and blank escutcheon) Arrow S3803 x SP02 Sargent 19-8810 x PTB
Residence hall wide stile entrance/exit doors with dogging and cylinder	Von Duprin 98DT (pull trim and cylinder) Arrow S3803 x SP03 Sargent 19-8804 x PTB
Rated opening requiring daytime passage and nighttime locking. Door is always latched.	Von Duprin 98 Series Double Cylinder Exit Device

D. Dead Bolts

1. Dead bolts shall be full-mortise Corbin Russwin ML2200 Series with thumb turn lever 519F10 and 2 ¾ inch backset, and with functions as listed below. Unless required to match existing hardware locations or noted on drawing, center of cylinder will be at 60 inches above the finished floor.
  - a. Salvage existing dead bolts, clean lubricate and reinstall. Use only for relatively new existing installations. Field check condition of existing.
  - b. Corbin Russwin ML 2217 is typical for gang toilet rooms for use by custodial and maintenance workers.

E. Push/Pull Units



1. Push/pull plates shall be stainless steel or bronze as required for the finish desired. Pull handles shall be solid forged metal with finish specified and be through bolted through plate and door. Punch push plate for cylinder when required by dead bolt. Unless otherwise noted, pull handles and plates shall be centered at 38 inches above the floor and push plates at 46 inches above the floor.

**PUSH/PULL UNIT SCHEDULE**

Salvage existing, reinstall	Use only for relatively new existing installations. Field check condition of existing.
Push plate	Baldwin 8" x 16" wrought push plate, 2210 or equal by Rockwood.
Push plate and handle	Baldwin 8" x 16" wrought pull plate 2110 with 2565 handle or equal by Rockwood.

F. Closers

1. All closers should be overhead, surface mounted closers, and must conform with ADA. **Concealed or floor closers are not acceptable. LCN Series 4040 is not acceptable.**

**CLOSERS SCHEDULE**

<b><u>Typical Usage</u></b>	<b><u>Maximum Size Interior Door</u></b>	<b><u>Maximum Size Exterior Door</u></b>	<b><u>LCN Catalog Number</u></b>	<b><u>Corbin Russwin Catalog Number</u></b>
Interior doors - High Frequency: Closer mounted on <u>pull</u> side of door.	Up to 54 inches	n/a	4011	DC8200
Interior doors - Low Frequency: Closer mounted on <u>pull</u> side of door. (offices, storage rooms, electrical, mechanical)	Up to 48 inches	n/a	4011	DC6200
Exterior doors, or interior doors where the closer cannot be mounted on the door side of the frame. This closer mounts on the room side of the frame. It requires four inches or more clearance above the door opening.	Up to 54 inches 60 inches	Up to 42" 60 inches	4021 4025 or 4026 sized to match door	DC8220 DC8220

Exterior doors, or interior doors where the closer cannot be mounted on the door side of the frame and the mounting space on the frame is less than four inches. Design the door header to avoid this closer when possible.	Up to 54 inches 60 inches	Up to 42" 60 inches	4021 with 18G plate 4025 or 4026 with 18G plate, sized to match door	DC8220 x 754F24
Exterior doors and interior doors - high frequency - where hold open is required.	Up to 54"	Up to 42"	4111 w/CUSH-N-STOP x H.O.	DC86210 x A5
Interior Doors – low frequency – where hold open is required (offices, storage rooms, electrical, mechanical)	Up to 48"	n/a	4111 w/ CUSH-N-STOP x H.O.	DC6210 x A5

G. Doorstops

**DOORSTOP SCHEDULE**

<b><u>Typical Usage</u></b>	<b><u>Doorstop</u></b>
Typical for lever handle locksets	Glynn-Johnson projected wall-mounted doorstop WB33.
Typical for all doors with knobs unless otherwise required by job condition	Ives wall mounted doorstop (408-1/2 at concrete or masonry, 406-1/2 at all wood and hollow walls with wood blocking, and 407-1/2 only at existing hollow walls having no blocking), or equal by Baldwin. Coordinate blocking in new walls with other trades.
Typical for overhead door control where there is no wall or no closer (e.g. student rooms).	Glynn Johnson 90/GJ900S
When using closer as a stop.	LCN door closer 4111 SHCNS (stop arm)

H. Kick Plates

1. **Kick plates are required on the push side of all doors that have door closers.** Kick plates shall be beveled on three sides and furnished with match oval head screws.
2. Salvage existing, clean and reinstall.
3. Rockwood 304 stainless steel kick plate -.050 inch x 16" high x width of door less 1 inch. Provide higher or lower protection when noted on door schedule.
4. Rockwood bronze kick plate -.050 inch x 16" high x width of door less 1 inch. Provide higher or lower protection when noted on door schedule. Use bronze only to match

existing; the bronze corrodes when the lacquer finish wears away. Provide trim protectors at high kick plates for doors with heavy cart traffic.

I. Weather-stripping

**WEATHERSTRIPPING SCHEDULE**

<b><u>Typical Usage</u></b>	<b><u>Weather-stripping</u></b>
Field-check condition of existing vinyl and pile seats. Note or specify replacement as required.	Salvage existing when appropriate, clean and reinstall.
At both jambs and head	Pemko extruded aluminum retainer with vinyl bulb, 306A or equal by Reese.
Typical heavy use door bottom on new hollow metal doors. Do not use this door bottom with plastic laminated doors as insufficient material is left for screws.	Pemko full mortise automatic door bottom, 434A or equal by Reese.
Typical heavy use door bottom for plastic laminate doors.	Pemko semi-mortise automatic door bottom, 430AM or equal by Reese.
Typical heavy use door bottom for existing hollow metal doors.	Pemko surface mounted automatic door bottom, 430AS or equal by Reese.
Typical lighter duty door bottom for new doors.	Pemko full mortise automatic door with neoprene sponge, 411 or equal by Reese.
Typical lighter duty door for existing hollow metal doors.	Pemko surface mounted automatic door bottom, 412 or equal by Reese.
Exterior Door Sweeps Exterior Door Thresholds	National Guard C607A or Pemko 18062 National Guard 425 or Pemko 175

J. Foot and Head Bolts

1. Foot and head bolts shall have 12-inch downset and 3/4 inch throw unless otherwise noted. Manual bolts shall have lever operation which allows for partial opening before engaging bolt.

**FOOT AND HEAD BOLT SCHEDULE**

<b><u>Typical Usage</u></b>	<b><u>Foot and Head Bolts</u></b>
Head bolt. Use only on non-labeled door openings.	Baldwin extension flush bolt 0610
Floor bolt. Use only on non-labeled door openings.	Baldwin extension flush bolt 0610. Provide Baldwin 0621 or 0622 dustproof strike. Set floor strike in epoxy or expanding grout. Coordinate type and installation of floor strike with floor material (tile, carpet, etc.).
Typical at labeled door opening. Avoid pairs of doors at labeled openings if possible by using ganged single doors.	Ives FB31P. Provide strike plates for active door leaf and dustproof floor strike. Set floor strike in epoxy or expanding grout. Coordinate type and installation of floor strike with floor material (tile, carpet, etc.).

K. Coordinators

1. Avoid door coordinators wherever possible by using removable door mullions.

**DOOR COORDINATOR SCHEDULE**

<b><u>Typical Usage</u></b>	<b><u>Foot and Head Bolts</u></b>
Salvage only roller type coordinators, and only in low traffic areas.	Salvage existing.
Use at low traffic areas with no potential for vandalism.	Ives projected coordinator with roller operation against active and inactive doors, model 469 or 469 1/2, or equal. Provide strikes and required accessories.
Use at high traffic openings and areas subject to vandalism.	Glynn-Johnson linear stop-mounted coordinator, Series COR, with fillers x size as required.

L. Removable Mullion

1. Salvage existing – check anchorage.
2. Von Duprin removable steel mullion KR4954 with MT54 storage unit x prime paint, or equal by Arrow or Sargent.

- M. Secret Latch
  - 1. Rockwood RW 602x26D or Major MRS 200 SPB or MRS 200 PA(AL)

1.9 HARDWARE FINISHES

- N. Unless noted elsewhere, finish of hardware listed in Scheduled Hardware shall have Dull Bronze or Dull Chromium finish as established by the U.S. Bureau of Standards and listed in the schedule below. Items of hardware not categorized below shall have finish best matching the selected finish series.

**HARDWARE FINISHES SCHEDULE**

<u>Item</u>	<u>Dull Bronze (DB) Finish Series</u>	<u>Dull Chromium (DC) Finish Series</u>
Hinges (All hinges shall have extra heavy copper base plating.)	US10	US26D
Locksets (latch sets)	US10	US26D
Panic Devices	US10	US32D (stainless)
Deadbolts	US10	US26D
Push/pull plates	US10	US26D
Doorstops	US10	US26D
Kick plates	US10	US32D or US10
Vision lite glass stops	Natural Anodized Aluminum	Natural Anodized Aluminum
Weather-stripping	Natural Anodized Aluminum	Natural Anodized Aluminum
Closers		
Wood	Dark Bronze	Aluminum
Plastic laminate	Dark Bronze	Aluminum
Hollow metal	Dark Bronze	Aluminum
Natural Anodized Aluminum	Dark Bronze	Aluminum
Dark Bronze Aluminum	Dark Bronze or KDP Dark if noted	Aluminum or KDP Dark if noted

1.10 INSTALLATION

- O. Install all new and/or rework existing hardware in compliance with the manufacturer's recommendations and as noted on Door Schedule and specified herein. Mortised items will be adjusted to fit flush.
- P. Do not install surface mounted items until finishes have been completed on the substrates involved.
- Q. Lubricate and adjust all hardware to operate properly.

END OF SECTION 087100

## SECTION 092613 - GYPSUM VENEER PLASTERING

### PART 1 - GENERAL

#### 1.1 ISSUES

- A. It is the intent that all gypsum veneer plaster used on its projects will comply with LEED™ NC 3 Credit Requirements MR Credit 4.1: Adhesives and Sealants.
- B. All gypsum board products will be applied ½" above floor level to minimize potential mold growth, unless gypsum board is required by fire rating to be installed to floor level.
- C. Patched openings in plaster construction shall be re-framed and lathed in as required to maintain original plaster thickness. Areas or openings to be patched shall have the existing finish coat chipped back one inch away from joint down to brown coat or base coat as required to overlap and bond new plaster patch to existing plaster. Areas to be patched or tied into shall be primed with an approved latex bonding agent in accordance with manufacturer's recommendations.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Gypsum veneer plaster and gypsum base for veneer plaster.
  - 2. Cementitious backer units for tile backing panels.
  - 3. Non-load-bearing steel framing.

#### 1.3 DEFINITIONS

- A. Terminology: Refer to ASTM C 11 for definitions of terms for gypsum veneer plaster assemblies not defined in this Section or in other referenced standards.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Submit printed VOC statement and product data for acoustical sealants and laminating adhesives in accordance with the General Administrative Requirements of the Construction Standards 01300.1.2. Maximum VOC content when calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168, effective July 1, 2005 and amended January 7, 2005:
  - 1. Acoustical Sealants for Exposed and Concealed Joints 250 g/l
  - 2. Auxiliary Materials/Laminating Adhesives 50 g/l

## 1.5 QUALITY ASSURANCE

- A. Source Limitations for Gypsum Veneer Plaster Products: Obtain gypsum veneer plaster products, including gypsum base, joint reinforcing tape, embedding material, and plasters, from a single manufacturer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.
  - 1. Gypsum Base for Veneer Plaster: Stack panels flat to prevent sagging.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 843 requirements or gypsum veneer plaster manufacturer's written recommendations, whichever are more stringent.
- B. Room Temperatures: Maintain not less than 55 deg F or more than 80 deg F for 7 days before application of gypsum base and gypsum veneer plaster, continuously during application, and after application until veneer plaster is dry.
- C. Avoid conditions that result in gypsum veneer plaster drying too rapidly.
  - 1. Distribute heat evenly; prevent concentrated or uneven heat on veneer plaster.
  - 2. Maintain relative humidity levels for prevailing ambient temperature that produces normal drying conditions.
  - 3. Ventilate building spaces in a manner that prevents drafts of air from contacting surfaces during veneer plaster application and until it is dry.

## PART 2 - PRODUCTS

### 2.1 STEEL FRAMING, GENERAL

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Dale Industries, Inc. - Dale/Incor.
  - 2. Dietrich Industries, Inc.
  - 3. Clark Steel Framing Systems.
  - 4. Unimast, Inc.
- B. Steel Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
  - 2. Protective Coating: G60, hot-dip galvanized zinc coating,



## 2.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.
- B. Hanger Attachments to Concrete:
  - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.
  - 1. Depth: 1-1/2 inches.
- F. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
  - 2. Steel Studs: ASTM C 645.
    - a. Minimum Base Metal Thickness: 0.0312 inch.
    - b. Depth: 3-5/8 inches.
  - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
    - a. Minimum Base Metal Thickness: 0.0312 inch]
- G. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
    - b. Chicago Metallic Corporation; Fire Front 630, Drywall Furring 640, Fire Front 650, Drywall Furring 660, Fire Front 670 System.
    - c. USG Interiors, Inc.; Drywall Suspension System.

## 2.3 STEEL PARTITION AND SOFFIT FRAMING

- A. Steel Studs and Runners: ASTM C 645.
  - 1. Minimum Base Metal Thickness: 0.0312 inch.
  - 2. Depth: 3-5/8 inches for ceiling heights up to 10 feet, and 6 inches for heights over 10 feet.

- B. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  - 1. Minimum Base Metal Thickness: 0.0312 inch.
  - 2. Depth: 7/8 inch].
- C. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
- D. Cold-Rolled Furring Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flanges.
  - 1. Depth: 3/4 inch.
  - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch.
  - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.
- E. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
- F. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

#### 2.4 GYPSUM VENEER PLASTER MATERIALS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Two-Component Gypsum Veneer Plaster:
    - a. United States Gypsum Co.:
      - 1) High-Strength Base Coat: IMPERIAL Basecoat Plaster.
      - 2) High-Strength, Smooth Finish Coat: IMPERIAL Finish Plaster
- B. Two-Component Gypsum Veneer Plaster: Separate formulations complying with ASTM C 587; one for base coat and one for finish coat application over substrates indicated.
  - 1. High-Strength Base Coat: Ready-mixed, base-coat plaster containing mill-mixed, fine silica sand; with a compressive strength of 3000 psi when tested according to ASTM C 472.
  - 2. High-Strength Finish Coat: Ready-mixed, smooth, finish-coat veneer plaster containing mill-mixed, fine silica sand; with a compressive strength of 3000 psi when tested according to ASTM C 472.
  - 3. Provide ready-mixed or job-sanded mix components, as standard for manufacturer, to comply with manufacturer's written recommendations.

#### 2.5 PANEL PRODUCTS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

- B. Gypsum Base for Veneer Plaster: ASTM C 588 and products of same manufacturer as plaster.
  - 1. Regular Type: 1/2 inch thick, unless otherwise indicated.
    - a. Location: Vertical and ceiling surfaces, unless otherwise indicated.
- C. Cementitious Backer Units: ANSI A118.9, 1/2 inch thick.
  - 1. Location: Tile substrates, unless otherwise indicated.
  - 2. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Custom Building Products; Wonderboard.
    - b. United States Gypsum Co.; DUROCK Cement Board.
    - c. National Gypsum Company; PermaBase.

## 2.6 TRIM ACCESSORIES

- A. Standard Trim: ASTM C 1047, provided or approved by manufacturer for use in gypsum veneer plaster applications indicated.
  - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
  - 2. Shapes:
    - a. Cornerbead: Use at outside corners, unless otherwise indicated.
    - b. Expansion (Control) Joint: Use where indicated.

## 2.7 JOINT REINFORCING MATERIALS

- A. General: Comply with joint strength requirements in ASTM C 587 and with gypsum veneer plaster manufacturer's written recommendations for each application indicated.
- B. Joint Tape:
  - 1. Gypsum Base for Veneer Plaster. Open-mesh, glass fiber.
  - 2. Cementitious Backer Units: As recommended by cementitious backer unit manufacturer.
- C. Embedding Material for Joint Tape:
  - 1. Gypsum Base for Veneer Plaster: Material produced and recommended by gypsum veneer plaster manufacturer for use with joint tape material and gypsum veneer plaster applications indicated.
  - 2. Cementitious Backer Units: Material recommended by cementitious backer unit manufacturer for applications indicated.

## 2.8 AUXILIARY MATERIALS

- D. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- E. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

## 2.9 GYPSUM VENEER PLASTER MIXES

- F. Mechanically mix gypsum veneer plaster materials to comply with ASTM C 843 and with gypsum veneer plaster manufacturer's written recommendations.

## 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. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

#### 3.3 INSTALLING STEEL FRAMING, GENERAL

- B. Installation Standards: ASTM C 754, and ASTM C 844 requirements that apply to framing installation.
- C. Install supplementary framing, blocking, and bracing at terminations in gypsum veneer plaster assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum veneer plaster manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- D. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
  1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
  2. Isolate partition framing and wall furring where they abut structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assemblies and laterally support assemblies.
- E. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

#### 3.4 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- F. Suspend ceiling hangers from building structure as follows:
  1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension

- system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
  4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  5. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  6. Do not attach hangers to steel deck tabs.
  7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- G. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.
- H. Screw furring to wood framing.
- I. Wire tie or clip furring channels to supports.
- J. Install suspended steel framing components in sizes and spacings indicated, but not less than those required by referenced steel framing and installation standards.
1. Hangers: 48 inches o.c.
  2. Carrying Channels (Main Runners): 48 inches o.c.
  3. Furring Channels (Furring Members): 16 inches o.c.
- K. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- 3.5 INSTALLING STEEL PARTITION AND SOFFIT FRAMING
- L. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum veneer plaster assemblies abut other construction.
- M. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.
- N. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum base panels.
- O. Install steel studs and furring at the following spacings:
1. Single-Layer Construction: 16 inches o.c., unless otherwise indicated.
  2. Cementitious Backer Units: 16 inches o.c., unless otherwise indicated.

- P. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
- Q. Frame door openings to comply with GA-600 and with gypsum veneer plaster manufacturer's written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
  - 1. Install two studs at each jamb, unless otherwise indicated.
  - 2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.
  - 3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- R. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

### 3.6 APPLYING PANELS, GENERAL

- S. Gypsum Base for Veneer Plaster: Apply according to ASTM C 844, unless manufacturer's written recommendations are more stringent.
  - 1. Do not allow gypsum base to fade from exposure to light.
  - 2. Erection Tolerance: No more than 1/16-inch offsets between planes of gypsum base faces, and 1/8 inch in 8 feet for level, plumb, warp, and bow.
- T. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- U. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- V. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- W. Attach panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- X. Attach panels to framing provided at openings and cutouts.
- Y. Do not attach panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float panels over these members using resilient channels, or provide control joints to counteract wood shrinkage.
- Z. Form control and expansion joints with space between edges of adjoining panels.
- AA. Cover both faces of steel stud partition framing with panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  2. Fit panels around ducts, pipes, and conduits.
  3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- BB. Isolate perimeter of non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with metal edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- CC. Floating Construction: Where feasible, including where recommended in writing by manufacturer, install panels over wood framing, with floating internal corner construction.
- DD. Fastener Spacing: According to referenced gypsum base for gypsum veneer plaster application standard, manufacturer's written recommendations, and fire-resistance-rating requirements.
1. Space screws a maximum of 12 inches o.c. for vertical applications.
  2. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

### 3.7 PANEL APPLICATION METHODS

EE. Single-Layer Application:

1. On ceilings, apply gypsum base panels before wall/partition panels to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum base panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
  - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

- FF. Single-Layer Fastening Methods: Apply gypsum base panels to supports with steel drill screws.
- GG. Cementitious Backer Units: Install according to ANSI A108.11.

1. Where cementitious backer units abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.

### 3.8 INSTALLING TRIM ACCESSORIES

- HH. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- II. Control Joints: Install control joints according to ASTM C 844 and in specific locations approved by Architect for visual effect.

### 3.9 INSTALLING JOINT REINFORCEMENT

- JJ. Gypsum Base for Veneer Plaster: Reinforce interior angles and flat joints with joint tape and embedding material to comply with ASTM C 843 and gypsum veneer plaster manufacturer's written recommendations.
- KK. Cementitious Backer Units: Reinforce joints between cementitious backer units with joint tape and embedding material according to unit manufacturer's written recommendations.

### 3.10 GYPSUM VENEER PLASTERING

- LL. Gypsum Veneer Plaster Application: Comply with ASTM C 843 and veneer plaster manufacturer's written recommendations.
  - 1. Where gypsum veneer plaster abuts metal door frames, windows, and other units in veneer plaster, groove finish coat to eliminate spalling.
- MM. Concealed Surfaces: Omit gypsum veneer plaster in the following areas where veneer plaster will be concealed from view in the completed Work, unless otherwise indicated or required to maintain fire-resistance rating. Do not omit veneer plaster behind cabinets, furniture, furnishings, and similar removable items.
  - 1. Above suspended ceilings.
  - 2. Behind wood paneling and other permanently applied wall or ceiling finishes.
- NN. Gypsum Veneer Plaster Finish: Smooth-troweled finish, unless otherwise indicated.

END OF SECTION 092613



## SECTION 093013 – CERAMIC TILING

### PART 1 - GENERAL

#### 1.1 ISSUES

- A. Typical locations for dry area ceramic tile installation include areas subject to heavy traffic, such as entrance lobbies and main hallways, where impermeability, stain and water resistance, and easy cleaning are foremost requirements. For installation of ceramic tile in areas where usage or anticipated cleaning process calls for waterproof installation, refer to Section 093400 – WATERPROOFING MEMBRANE TILING.
- B. When installing tile as part of rehabilitation or repair of existing tiled surfaces, match existing type, texture, size, thickness, edge shapes and variations in color. Submit samples for selection.
- C. When a tile system is installed, will expect a special warranty as follows:
  - 1. Warranty must be provided by the setting materials manufacturer and shall cover the complete flooring system, including all labor and materials. Warranty period shall be for a period of five years from date of installation, and shall warrant the installed assembly to be free from manufacturing and installation defects.
  - 2. During the warranty period, will require defective work to be restored to the standard of the Contract Documents, including labor and materials and other costs incidental to the Work. Within 24 hours after receipt of notice from the Owner, the Work must be inspected. Work found defective as defined in the contract documents will be restored within 10 days after receipt of notice from the owner.
- D. It is the intent that all ceramic tile installation used on its projects will comply with LEED™ NC 3 Credit Requirements MR Credit 4.1: Adhesives and Sealants.
- E. It is the intent that all ceramic tile, materials, and methods of installation shall meet the latest ICC/ANSI A117.1 standards for slip resistance and provide barrier free access for mobility and physically impaired users.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Ceramic mosaic tile.
  - 2. Glazed wall tile
  - 3. Paver tile.
  - 4. Crack-suppression membrane for thin-set tile installations.
  - 5. Metal edge strips installed as part of tile installations.
- B. Related Sections include the following:
  - 1. Division 03 Section CAST-IN-PLACE CONCRETE for monolithic slab finishes specified for tile substrates.
  - 2. Division 07 Section JOINT SEALANTS for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

3. Division 09 Section GYPSUM VENEER PLASTERING for cementitious backer units.
4. Division 09 Section PORTLAND CEMENT PLASTERING for portland cement scratch coat over metal lath on wall surfaces.
5. Division 09 Section WATERPROOFING MEMBRANE TILING for tile installation in swimming pools, showers, toilets, kitchens, or surgeries where usage or anticipated cleaning process calls for waterproof installation.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
  1. Level Surfaces: Minimum 0.6.
  2. Step Treads: Minimum 0.6.
  3. Ramp Surfaces: Minimum 0.8.

### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: If requested, show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Projects involving replacement of existing tile floors will be mapped as specified in this Section, and the resulting document submitted to the Project Representative prior to demolition of the old floor.
- D. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.
- E. Samples for Verification, if requested:
  1. Full-size units of each type and composition of tile and for each color and finish required.
  2. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches square and mounted on rigid panel. Use grout of type and in color or colors approved for completed work.
  3. Full-size units of each type of trim and accessory for each color and finish required.
  4. Stone thresholds in 6-inch lengths.
  5. Metal edge strips in 6-inch lengths.
- F. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- G. Product Certificates: For each type of product.
- H. Qualification Data: For Installer. Provide documentation that the installer is approved or licensed by the setting bed manufacturer and demonstrating experience with the floor system being installed.
- I. Material Test Reports: For each tile-setting and -grouting product.

- J. Maintenance instruction for each type of tile.
- K. Provide extra tile for future replacement of damaged tile. The type and amount should be verified with the Project Manager.
- L. Submit printed VOC statement and product data for adhesives, grout and sealant in accordance with the General Administrative Requirements of the Construction Standards 01300.1.2. Maximum VOC content when calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168, effective July 1, 2005 and amended January 7, 2005:
  - 1. Adhesives 65 g/l
  - 2. Epoxy Grouts 65 g/l
  - 3. Elastometric Sealants 250 g/l
- M. Warranties: Submit written special warranty as specified in this Section. Include contact information, description of coverage, and start date for each special warranty.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.
  - 1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer. Grout, setting bed, and underlayments shall be by the same manufacturer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
  - 1. Joint sealants.
  - 2. Metal edge strips.

#### 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 requirement in ANSI A137.1 for labeling sealed 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 avoided.
- D. Store liquid latexes in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

## 1.7 PROJECT CONDITIONS

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

## PART 2 - PRODUCTS

### 2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.
- C. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, 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. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

### 2.2 TILE PRODUCTS

- A. Tile will be solid body porcelain ceramic. If larger format tile than 6x6 is used at areas with new or existing floor drains, dimension and jointing /cut pattern must be considered in advance to accommodate the required slope to drains – typically 1/8" per foot minimum. Verify slope requirements and drain placement per specific project. Avoid glazed or textured floor tile in all but lowest traffic situation installation.
- B. Glazed Wall Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
  - 1. Base for Portland Cement Mortar Installations: Coved, module size to match with adjoining flat tile.
  - 2. Base for Thin-Set Mortar Installations: Straight, module size to match with adjoining flat tile.
  - 3. Wainscot Cap for Portland Cement Mortar Installations: Bullnose cap, module size to match with adjoining flat tile.
  - 4. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size to match with adjoining flat tile.
  - 5. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above.
  - 6. External Corners for Portland Cement Mortar Installations: Bullnose shape with radius of at least 3/4 inch, unless otherwise indicated.
  - 7. External Corners for Thin-Set Mortar Installations: Surface bullnose.
  - 8. Internal Corners: Field-buttet square corners except with coved base and cap angle pieces designed to fit with stretcher shapes.

- C. Accessories for Glazed Wall Tile: Provide vitreous china accessories of type and size indicated, in color and finish to match adjoining wall tile, and intended for installing by same method as adjoining wall tile.

## 2.3 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes. Use granite threshold in lieu of marble in high traffic openings.

## 2.4 FLOOR SYTEM

### A. UNDERLAYMENTS

#### 1. Thin Mortar Bed Underlayments (0 to ¾" thick).

- a. Thin underlayments will be factory pre-blended mixes of graded sand aggregates, Portland cement, and an acrylic/latex admixture. Products will be designed for the thickness to be installed. These products will also be used as a mortar bed on top of the membrane around floor drains and other areas that may require additional grading.
- b. Products:
  - 1) LATACRETE International Inc., Latacrete 226 & 3701.
  - 2) MAPEI Corporation, Mapecem Premix and Planicrete AC.
  - 3) MER-KRETE Systems: Underlay-L or Underlay M.
  - 4) Or approved equal.

#### 2. Thick Mortar Bed Underlayment (greater than ¾" thick).

- a. These materials may be the same as the thin mortar bed underlayment materials above, or site mixed of graded sand, Portland cement, and an acrylic/latex admixture. Mixture shall exceed the following properties:
  - 1) Compressive Strength/ASTM 190 4500 psi
  - 2) Tensile Strength/ASTM 190 350 psi
  - 3) Flexural Strength/ASTM C348 1800 psi
  - 4) Shear Bond Strength 470 psi
- b. Site mixed underlayment shall be:
  - 1) 3 parts sand and 1 part cement with 1 part Acryl 60 and 1 part water, or
  - 2) 3 parts sand and 1 part cement with 1 part Planicrete AC.
- c. Reinforcing Wire Fabric: Galvanized welded wire fabric, 2 inches by 2 inches complying with ASTM A185 and ASTM A82.

### B. Crack Suppression Membrane:

- 1. Fabric reinforced two-part liquid rubber membrane to provide crack bridging over concrete shrinkage cracks and other non-structural cracks.
- 2. Products:
  - a. LATICRETE International Inc., Laticrete Blue 92 Anti-Fracture Membrane.
  - b. MAPEI Corporation, Mapelastic L.
  - c. MER-KRETE Systems, Hydrosshield 6000.
  - d. Or approved equal.

C. Thin Setting Mortar:

1. Manufactured graded sand aggregate and Portland cement, and acrylic latex admixture exceeding ANSI A118.4.
2. Products:
  - a. LATICRETE International Inc., Laticrete 272 & 3701.
  - b. MAPEI Corporation, Keralastic with Kerabond.
  - c. MER-KRETE Systems, Mer-Krete 720 with Mer-Krete 150 Acrylic/Latex.
  - d. Or approved equal.

D. Waterproofing membrane:

1. If indicated, see Section 093400 – WATERPROOFING-MEMBRANE TILING.

E. Grout:

1. 100% solid epoxy grout exceeding ANSI A118.3, chemical resistant and water cleanable.
2. Products:
  - a. LATICRETE International Inc., Latipoxy.
  - b. MAPEI Corporation, Kerapoxy.
  - c. MER-KRETE Systems, Mer-Poxy.
  - d. Or approved equal.

2.5 WALL SYSTEM:

A. Portland Cement Mortar Base:

1. Use at existing walls and irregular wall conditions.
2. Products:
  - a. 2 parts graded sand to 1 part Portland cement.
  - b. MAPEI Corporation – Scratch Coat Mortar
  - c. Or approved equal.
3. Expanded metal lath: Provide diamond mesh lath complying with ASTM C847 for requirements as follows:
  - a. Fabricate lath from zinc-coated steel sheet
  - b. Self-furring.
  - c. Weight:  $\frac{3}{4}$  lb/sq. ft.
4. Cleavage Membrane: Asphalt felt – 15 lb., ASTM D226, Type I.
5. Vapor Barrier: 6-mil polyethylene sheeting.

B. Thin Setting Mortars

1. Use at new walls and other clean concrete surfaces (same as for floor systems.)
2. Manufactured graded sand aggregate and Portland cement, and acrylic/latex admixture exceeding ANSI A118.4.
3. Products:

- a. LATICRETE International Inc., Laticrete 272 & 3701.
  - b. MAPEI Corporation, Mapecem Premix & Planicrete AC.
  - c. MER-KRETE Systems, Mer-Krete 720 with Mer-Krete 150 Acrylic/Latex.
  - d. Or approved equal.
4. When installing new tile over the ground masonry surface of old wall tile, use a rubber-based setting adhesive.
- C. Waterproofing membrane:
1. If indicated, see Section 093400 – WATERPROOFING-MEMBRANE TILING.
- D. Grout.
1. 100% solid epoxy grout exceeding ANSI A118.3, chemical resistant and water cleanable.
  2. Products:
    - a. LATICRETE International Inc., Latipoxy.
    - b. MAPEI Corporation, Kerapoxy.
    - c. MER-KRETE Systems, Mer-Poxy.
    - d. Or approved equal.

## 2.6 ELASTOMERIC SEALANTS

- A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 7 Section "Joint Sealants."
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.
- C. For non-traffic surfaces provide One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
1. Available Products:
    - a. Dow; DOWSIL 786 Silicone Sealant - M
    - b. GE Silicones; Sanitary 1700.
    - c. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
    - d. Tremco, Inc.; Tremsil 600 White.
- D. Chemical-Resistant Sealants: For chemical-resistant floors, provide chemical-resistant elastomeric sealant of type recommended and produced by chemical-resistant mortar and grout manufacturer for type of application indicated, with proven service record and compatibility with tile and other setting materials, and with chemical resistance equivalent to mortar/grout. Include primer and backer rod recommended by manufacturer.
- E. Chemical-Resistant Sealants: For chemical-resistant floors, provide chemical-resistant elastomeric sealant of type recommended and produced by chemical-resistant mortar and grout manufacturer for type of application indicated, with proven service record and compatibility with

tile and other setting materials, and with chemical resistance equivalent to mortar/grout. Include primer and backer rod recommended by manufacturer.

## 2.7 MISCELLANEOUS MATERIALS

- A. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic base, designed specifically for flooring applications, stainless steel; ASTM A 666, 300 Series exposed-edge material.
  - 1. Products:
    - a. Schluter Systems DILEX\_AKWS.
    - b. Or approved equal.
- B. Control Joints: Aluminum legs and flanges with thermoplastic rubber movement zone.
  - 1. Products:
    - a. Schluter Systems DILEX-AKWS.
    - b. Or approved equal.
- C. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
  - 1. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
- D. Tile Cleaner: A cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers. Emene cleaners will be used sparingly as approved by the setting bed manufacturer. These cleaners will be used as soon after installation as practical to make cleaning easier.

## 2.8 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
  - 1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
  - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile have been completed before installing tile.
  - 3. Installer shall map out all existing cracks in existing floor finishes before demolition begins so that the structural slab can be examined and investigated for the cause of such tracing in the mapped locations after demolition is complete.
  - 4. To preclude an unacceptable level of moisture in or being emitted from substrates, verify that substrate is acceptable for installation of setting bed and tile as determined by respective manufacturer's moisture testing procedure for concrete slabs or other substrates.
  - 5. 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 and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.
- B. Provide concrete substrates for tile floors installed with thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
  - 1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
  - 2. Remove protrusions, bumps, and ridges by sanding or grinding.
  - 3. On renovation projects where existing setting bed material is being removed, no soft or unbonded or otherwise unsound material will be left in place.
- C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- D. Field-Applied Temporary Protective Coating: Where 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.
- E. Protect the work and adjacent construction against damage during progress of the work until completion.

### 3.3 INSTALLATION, GENERAL

- A. Install wall tile first, then floor tile. Start installation of the wall tile at the lowest point of floor slopes so that the grout joint between wall tile and floor tile will be on the horizontal surface.
- B. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- C. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Unless otherwise specified, comply with TCA installation methods indicated in ceramic tile installation schedules.
- D. 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.
- E. Avoid laying patterns of accent tiles near adjacent walls that would accent wall irregularities.
- F. 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.
- G. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
  - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
- H. Lay out tile wainscots to next full tile beyond dimensions indicated.
- I. Expansion Joints: Locate expansion joints and other joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
  - 1. Locate joints in tile surfaces directly above joints in concrete substrates.
- J. Grout tile to comply with requirements of the following tile installation standards:
  - 1. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

### 3.4 CRACK-SUPPRESSION MEMBRANE INSTALLATION

- A. Install crack-suppression membrane to comply with manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.

### 3.5 FLOOR TILE INSTALLATION

- 1. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.

- a. Tile floors composed of tiles 8 by 8 inches or larger.
- B. With the approval of the project representative that the structural slab is ready for new work, repair or prepare all cracks with the appropriate method.
- C. Joint Widths: Install tile on floors with the following joint widths unless otherwise indicated:
  - 1. Ceramic Mosaic Tile: 1/16 inch.
  - 2. Porcelain Ceramic Tile: 1/8 inch.
- D. Stone Thresholds: Install stone thresholds set in same type of setting bed as abutting field tile, unless otherwise indicated.
- E. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

### 3.6 WALL TILE INSTALLATION

- A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.
- B. Set tile in a bond coat of latex Portland cement mortar in compliance with ANSI A108.5 and mortar manufacturer's instructions.
- C. Where wall substrate irregularities exceed 1/4" in 8 feet, apply a leveling bed.
  - 1. Clean and roughen wall surfaces as require to thoroughly bond leveling bed.
  - 2. Apply mortar to required thickness and carefully screed surface to true, accurate plane. Cure under vaporproof membrane or other approved method for not less than 3 days before installing tile.
- D. Joint Widths: Install tile on walls with the following joint widths unless otherwise indicated:
  - 1. Ceramic Mosaic Tile: 1/16 inch.
  - 2. Porcelain Ceramic Tile: 1/8 inch.

### 3.7 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
  - 1. Remove grout residue from tile as soon as possible.
  - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
  - 3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

- B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
- C. Post suitable notices to prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Protect waterproof membrane prior to and during the installation.
- E. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.
- F. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. No other trades will work on tile floors until epoxy grout is fully cured and cleaned from the surface of the tile.

END OF SECTION 093013

## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 ISSUES

1. It the intent that all joint sealants used on its projects will comply with LEED™ NC 3 Credit Requirements EQ Credit 4.1: Low-Emitting Materials: Adhesives and Sealants.
2. If a project involves removal of ceiling panels in sufficient quantity for recycling under the programs by USG and Armstrong, tiles will be stacked on pallets and stored in a dry location until they are picked up for recycling by a panel manufacturer.

#### 1.2 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Related Sections include the following:
  1. Division 07 Section JOINT SEALANTS.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated and including VOC Statements for Sealants and Adhesives.
- B. Maintenance Data: For finishes to include in maintenance manuals.
- C. Certificate of Accreditation: Provide certificate as described in this section.
- D. Scope of Accreditation: Provide scope as described in this section.

#### 1.4 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- B. Source Limitations:
  1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
  2. Suspension System: Obtain each type through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Surface-Burning Characteristics: Provide acoustical panels with surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

#### 1.5 DELIVERY, STORAGE, AND HANDLING

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

#### 1.6 PROJECT CONDITIONS

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

#### 1.7 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

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

3.1 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
  - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

3.2 CAST OR MOLDED, MINERAL-BASE ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

- A. Available Manufacturers:
  - 1. Armstrong World Industries, Inc.
  - 2. BPB Celotex Corporation; Architectural Ceilings Marketing Dept.
  - 3. National Gypsum
  - 4. USG Interiors. Inc.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
  - 1. Type and Form: Type III, mineral base with painted finish; Form 4, cast or molded.
- C. Color: White
- D. Edge Detail: Reveal sized to fit flange of exposed suspension system member.
- E. Thickness: ¾ inch.
- F. Size: 24 by 24 inches.

3.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
  - 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
  - 1. 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 hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
  - 1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.
- E. Joint Sealants: See 07 Section JOINT SEALANTS.

### 3.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING:

- A. Available Manufacturers:
  - 1. Armstrong World Industries, Inc.
  - 2. BPB Celotex Corporation; Architectural Ceilings Marketing Dept.
  - 3. Chicago metallic Corporation
  - 4. USG Interiors, Inc.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 15/16-inch- wide metal caps on flanges.
  - 1. Structural Classification: Intermediate-duty system.
  - 2. End Condition of Cross Runners: Butt-edge type.
  - 3. Face Design: Flat, flush.
  - 4. Cap Material: Steel cold-rolled sheet.
  - 5. Cap Finish: Painted white .

### 3.5 METAL EDGE MOLDINGS AND TRIM

- A. Available Manufacturers:
  - 1. Armstrong World Industries, Inc.
  - 2. BPB Celotex Corporation; Architectural Ceilings Marketing Dept.
  - 3. Chicago Metallic Corporation.
  - 4. Fry Reglet Corporation.
  - 5. Gordon, Inc.
  - 6. MM Systems, Inc.
  - 7. USG Interiors, Inc.
- B. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel



edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

#### PART 4 - EXECUTION

##### 4.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

##### 4.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

##### 4.3 INSTALLATION, GENERAL

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- 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. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
  4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures 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. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  6. Do not attach hangers to steel deck tabs.

7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  8. 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.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
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, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
    - a. Install panels with pattern running in one direction parallel to long axis of space.
  2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

#### 4.4 CLEANING

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

END OF SECTION 095113

## SECTION 096513 - 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. Resilient base.
  - 2. Resilient stair accessories.
  - 3. Resilient molding accessories.

#### 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.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Resilient base and stair accessories shall comply with requirements of FloorScore certification.
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

#### 2.2 THERMOPLASTIC-RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. As indicated on Drawings.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
  - 1. Group: I (solid, homogeneous).
  - 2. Style and Location:

- a. Style A, Straight: Provide in areas with carpet.
  - b. Style B, Cove: Provide in areas with resilient flooring.
- C. Thickness: 0.125 inch.
- D. Height: 4 inches for carpeted areas, 4 inches coved at non-carpet areas.
- 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: As selected by Architect from full range of industry colors.

### 2.3 VINYL BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. As indicated on Drawing.
- B. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).
- 1. Group: I (solid, homogeneous).
  - 2. Style and Location:
    - a. Style A, Straight: Provide in areas with carpet.
    - b. Style B, Cove: Provide in areas with resilient flooring.
- C. Thickness: 0.125 inch.
- D. Height: 4 inches for carpeted areas, 4 inches coved at non-carpet areas.
- 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: As selected by Architect from full range of industry colors.

### 2.4 RUBBER MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Roppe Corporation, USA.
  - 2. VPI, LLC, Floor Products Division.
  - 3. Nora.

- B. Locations: Provide rubber molding accessories in areas indicated.
- C. Colors and Patterns: As selected by Architect from full range of industry colors.

## 2.5 VINYL MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
  - 3. Flexco.
  - 4. Johnsonite; A Tarkett Company.
  - 5. Musson Rubber Company.
  - 6. Nora.
  - 7. Roppe Corporation, USA.
- B. Description: Vinyl nosing for resilient flooring, reducer strip for resilient flooring, joiner for tile and carpet and transition strips.
  - 1. Corner bumper guards.
  - 2. Chair rail molding.
- C. Profile and Dimensions: As indicated.
- D. Locations: Provide vinyl molding accessories in areas indicated.
- E. Colors and Patterns: As selected by Architect from full range of industry colors.

## 2.6 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
  - 1. Adhesives shall have a VOC content of 50 g/L or less except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.
  - 2. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

## PART 3 - EXECUTION

### 3.1 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: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:
    - a. Perform anhydrous calcium chloride test according to 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. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.
- 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 resilient products until they are the same temperature as the space where they are to be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 3.2 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.

### 3.3 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
  - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
  - 2. Tightly adhere to substrates throughout length of each piece.
  - 3. 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.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
  - 1. Apply two coat(s).
- C. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

## SECTION 096519 - RESILIENT TILE FLOORING

### PART 1 - GENERAL

#### 1.1 ISSUES

- A. Heavy marbled or terrazzo type patterns are preferred. Extremely light or dark colors should not be selected.
- B. The factory applied finish on the tile shall be removed using a floor-scrubbing machine and the stripper prepared by the manufacturer of the wax to be applied; and a new finish applied. The Project Manager will contact Housing and Food Services or Physical Plant Custodial Services to identify the current finish being used.
- C. It is the intent that all resilient floor tile installation used on its projects will comply with LEED™ NC 2.2 Credit Requirements EQ Credit 4.1: Low Emitting Materials: Adhesives and Sealants
- D. It is the intent that all resilient tile flooring materials and methods of installation shall meet the latest ICC/ANSI A117.1 standards for slip resistance and provide barrier free access for mobility and physically impaired users.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Vinyl composition tile (VCT).
  - 2. Resilient wall base and accessories.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required.
  - 1. Resilient Wall Base and Accessories: Manufacturer's standard-size Samples, but not less than 12 inches long, of each resilient product color and pattern required.
- C. Maintenance Data: For resilient products to include in maintenance manuals.
- D. Submit printed VOC statement and product data for adhesives in accordance with the General Administrative Requirements of the Construction Standards 01300.1.2. Maximum VOC content when calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168, effective July 1, 2005 and amended January 7, 2005:
  - 1. Cove Base Adhesives 50 g/l
  - 2. Rubber Floor Adhesives 60 g/l



#### 1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

#### 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. Store tiles on flat surfaces.

#### 1.6 PROJECT CONDITIONS

- A. Maintain 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 time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After postinstallation period, maintain 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 covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install resilient products after other finishing operations, including painting, have been completed.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Floor Tile: Furnish 2 boxes of each type, color, and pattern of floor tile installed.
  - 2. Resilient Wall Base and Accessories: Furnish not less than 20 linear feet of each type, color, pattern, and size of resilient product installed.

### PART 2 - PRODUCTS

#### 2.1 VINYL COMPOSITION TILE

- A. Vinyl Composition Tile (VCT): ASTM F 1066.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AB ColorPlus, American Biltrite (Canada) Ltd.
2. Armstrong World Industries, Inc.
3. Azrock Commercial Flooring, DOMCO.
4. Congoleum Corporation.
5. Mannington Mills, Inc.
6. Tarkett Inc.

C. Class: 2 (through-pattern tile)].

D. Wearing Surface: Smooth.

E. Thickness: 0.125 inch.

F. Size: 12 by 12 inches.

G. Fire-Test-Response Characteristics:

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

## 2.2 RESILIENT WALL BASE

A. Wall Base: ASTM F 1861.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following

1. AFCO-USA, American Floor Products Company, Inc.
2. Armstrong World Industries, Inc.
3. Azrock Commercial Flooring, DOMCO.
4. Burke Mercer Flooring Products.
5. Roppe Corporation.
6. VPI, LLC, Floor Products Division.
7. Johnsonite®

C. Type (Material Requirement): TV (vinyl).

D. Group (Manufacturing Method): I (solid, homogenous).

E. Style: Cove (with top-set toe) for installation on resilient flooring. Straight (toeless) for installation on carpeted flooring.

F. Minimum Thickness: 0.125 inch.

G. Height: 4 inches.

H. Lengths: Coils in manufacturer's standard length.

I. Outside Corners: Job formed.

J. Inside Corners: Job formed.

K. Surface: Smooth.

## 2.3 RESILIENT STAIR ACCESSORIES

- A. Treads: FS RR-T-650.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
  - 1. AFCO-USA, American Floor Products Company, Inc.
  - 2. Burke Mercer Flooring Products.
  - 3. Estrie, American Biltrite (Canada) Ltd.
  - 4. Johnsonite.
  - 5. Mondo Rubber International, Inc.
  - 6. Musson, R. C. Rubber Co.
  - 7. R.C.A. Rubber Company (The).
  - 8. Roppe Corporation.
- C. Material: Rubber, Composition A.
- D. Surface Design: Type 2 design (designed).
- E. Size: Lengths and depths to fit each stair tread in one piece or, for treads exceeding maximum lengths manufactured, in equal-length units.
- F. Risers: Smooth, flat, toeless, height and length to cover risers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
  - 1. Thickness: 0.125 inch

## 2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
- C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

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.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations 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. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
  3. Moisture Testing:
    - a. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- C. 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.
- D. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- E. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- F. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
  1. Do not install resilient products until they are same temperature as space where they are to be installed.
- G. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 TILE INSTALLATION

- A. Lay out 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 square with room axis.
- B. Match 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.

- C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- D. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- E. 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, nonstaining marking device.
- F. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- G. Adhere tiles to flooring 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.

#### 3.4 RESILIENT WALL BASE INSTALLATION

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
- F. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

#### 3.5 RESILIENT ACCESSORY INSTALLATION

- A. Resilient Stair Accessories:
  - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
  - 2. Tightly adhere to substrates throughout length of each piece.
  - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

### 3.6 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
    - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
  - 1. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 096519

## SECTION 096800 – CARPETING

### PART 1 - GENERAL

#### 1.1 ISSUES

- A. Broadloom and/or carpet tile may be used depending on existing conditions and design intent in residential, dining, lounge and administrative spaces of Housing and Food Services buildings. In Academic buildings, the typical areas for carpet are administrative, auditoriums, libraries, conference rooms, large lecture halls, reception rooms and lounges. Classroom carpeting is not recommended. Carpeting is not recommended for any ground floor public lobby, due to high maintenance required for winter slush and salt, and will be permitted in those locations only with the approval of both IPF Planning, Design and Construction, and IPF Building Services. Carpet shall meet flame, smoke and other code mandated fire safety standards.
- B. Direct glue down installation is preferred. The use of carpet cushion in corridors, classrooms, lobbies and places of public assembly is discouraged
- C. Computer room carpeting shall be especially constructed for use in computer rooms with permanent anti-static properties at a level acceptable to the computer manufacturer (typically 2.0 or less.)
- D. When base is specified in conjunction with the carpet, it shall be square-cut straight 4-inch vinyl base, installed prior to the installation of the carpet. It shall be glued to the walls and base cabinets, with field formed corner pieces jointed at least two-feet beyond the corner. Color shall be dark brown or black consistent with the building standard.
- E. Broadloom carpet shall be installed with as few seams as possible. All seams shall be seam sealed.
- F. Carpet without cushion shall be glued to the substrate. Carpet with cushion shall have cushion glued directly to the substrate. Carpet over cushion shall be installed using the double stick method.
- G. All scraps of carpet larger than ten square feet shall be delivered to the Project Representative to be stored at the building for future repairs.
- H. It is the intent that all carpet and carpet tile installation used on its projects will comply with LEED™ NC 2.2 Credit Requirements EQ Credit 4.1: Adhesives and Sealants and LEED NC 2.2 Credit Requirements EQ Credit 4.3: Low-Emitting Materials Carpets for carpets and installation accessories.

#### 1.2 SUMMARY

- I. This Section includes the following:
  - 1. Tufted carpet.
  - 2. Woven carpet.
  - 3. Carpet cushion.
  - 4. Carpet Tile

### 1.3 SUBMITTALS

- J. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate required.
- K. Provide an installation diagram from the carpet installer prior to installation. It will include the following as applicable to the project:
1. Columns, doorways, enclose walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
  2. Carpet type, color, and dye lot.
  3. Seam locations, types, and methods.
  4. Type of installation.
  5. Pattern type, repeat size, location, direction, and starting point.
  6. Pile direction.
  7. Type, color, and location of insets and borders.
  8. Type, color, and location of edge, transition, and other accessory strips.
  9. Transition details to other flooring materials.
  10. Type of cushion.
- L. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet: 12-inch- square Sample.
  2. Exposed Edge Stripping and Accessory-: 12-inch- long Samples.
  3. Carpet Cushion: 6-inch- square Sample.
  4. Carpet Seam: 6-inch Sample.
- M. Maintenance Data: Provided prior to installation of the carpeting and including the following:
1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  2. Precautions for cleaning materials and methods that could be detrimental to carpet.
- N. Submit printed VOC statement and product data for carpet and installation accessories in accordance with the General Administrative Requirements of the Construction Standards 01300.1.2. Submit documentation for carpet materials of compliance with the Carpet and Rug Institute (CRI) Green Label Plus Testing Program [www.carpet-rug.com/](http://www.carpet-rug.com/). Installation Adhesives Maximum VOC content when tested according to ASTM D 5116: 2-Ethyl-1-Hexanol: 3.00 mg/sq. m x h and also certified as compliant with CRI Green Label Plus testing program.

#### 1.4.1 QUALITY ASSURANCE

- O. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- P. General: Comply with CRI 104, Section 5, "Storage and Handling".



- Q. All carpet shall be shipped to the site in original factory wrappings bearing labels verifying that all carpet is from the same dye lot. Carpet shall be delivered to the job site at least 48 hours prior to installation.

## 1.6 PROJECT CONDITIONS

- R. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."  
S. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.  
T. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.  
U. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

## PART 2 - PRODUCTS

### 2.1 CARPET

- A. Pattern: Soil and traffic hiding patterns are preferred. Solid colors should be used with discretion.  
B. Fiber Content: Minimum 80% solution dyed nylon.  
C. Face Construction: Level-loop pile or cut and loop pile.  
D. Surface Pile Weight: Minimum 28 oz per sq yd.  
E. Primary Backing: Polypropylene.  
F. Width: Of width appropriate to require fewest possible seams.  
G. Performance Characteristics: As follows:
1. Anti-static rating less than 3.0 KV.
  2. Critical Radiant Flux Classification: ASTM E-648 Class I (Not less than 0.45 W/sq. cm.)
  3. Methenamine Pill Test ASTM D 2859. Pass Doc FF 1-70, 16 CFR 1630.
  4. Smoke Density: ASTM E-662 Dm. 0-450.

### 2.2 CARPET CUSHION

- A. The use of carpet cushion in corridors, classrooms, lobbies and places of public assembly is discouraged. When carpet cushion is used, it shall be of entirely synthetic and inert durable construction, reinforced and resilient to wheel wear, and which may be glued directly to the floor by double stick application. The use of animal hair and organic fibers is not permitted.

## 2.3 CARPET TILE

- A. Pattern: Soil and traffic hiding patterns are preferred. Solid colors should be used with discretion. Tiles should always be non-directional.
- B. Fiber Content: Minimum 80% solution dyed nylon.
- C. Face Construction: Level-loop pile or cut and loop pile.
- D. Surface Pile Weight: Minimum 20 oz per sq yd.
- E. Backing: Synthetic cushion.
- F. Performance Characteristics: As follows:
  - 1. Anti-static rating less than 3.0 KV.
  - 2. Critical Radiant Flux Classification: ASTM E-648 Class I (Not less than 0.45 W/sq. cm.)
  - 3. Methenamine Pill Test ASTM D 2859. Pass Doc FF 1-70, 16 CFR 1630.
  - 4. Smoke Density: ASTM E-662 Dm. 0-450.

## 2.4 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the carpet manufacturer or carpet cushion manufacturer, as appropriate.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and that is recommended by the carpet manufacturer or carpet cushion manufacturer, as appropriate:
- C. Seaming Cement: Product recommended by carpet manufacturer for butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- D. Molding: Vinyl of appropriate width and height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the carpet manufacturer or carpet cushion manufacturer, as appropriate.

2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. For wood subfloors, verify the following:

1. Underlayment over subfloor complies with requirements specified in Division 6 Section "Rough Carpentry."
2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- E. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.
- F. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- G. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by the carpet manufacturer or carpet cushion manufacturer, as appropriate:
- H. Broom and vacuum clean substrates to be covered immediately before installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- I. Direct-Glue-Down Installation: Comply with CRI 104, Section 8, and "Direct Glue-Down Installation."
- J. Double-Glue-Down Installation: Comply with CRI 104, Section 9, and "Double Glue-Down Installation."
- K. Carpet with Attached-Cushion Installation: Comply with CRI 104, Section 10, and "Attached Cushion."
- L. Carpet with Preapplied Adhesive Installation: Comply with CRI 104, Section 10.4, "Pre-Applied Adhesive Systems (Peel and Stick)."
- M. Stair Installation: Comply with CRI 104, Section 12, and "Carpet on Stairs."
- N. Comply with carpet manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- O. Do not bridge building expansion joints with carpet.

- P. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- Q. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- R. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- S. Install pattern parallel to walls and borders.
- T. Install carpet cushion seams at 90-degree angle with carpet seams.

### 3.4 CLEANING AND PROTECTION

- U. Perform the following operations immediately after installing carpet:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
  - 2. Remove yarns that protrude from carpet surface.
  - 3. Vacuum carpet using commercial machine with face-beater element.
- V. Protect installed carpet to comply with CRI 104, Section 15, and "Protection of Indoor Installations."
- W. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

END OF SECTION 096800

## SECTION 097200 - WALL COVERINGS

### PART 1 - GENERAL

#### 1.1 ISSUES

- A. Wall coverings are typically used in special areas only, such as reception rooms, dining rooms, or conference rooms.
- B. It is the intent that all wall covering installation used on its projects will comply with LEED™ NC 2.2 Credit Requirements MR Credit 4.1: Adhesives and Sealants.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Vinyl wall covering.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include data on physical characteristics, durability, fade resistance, and flame-resistance characteristics.
- B. Samples for Verification: Full width by 36-inch- long section of wall covering from dye lot to be used for each type of wall covering indicated for each color, texture, and pattern required. Show complete pattern repeat.
- C. Maintenance Data: For wall coverings to include in maintenance manuals.
- D. Submit printed VOC statement and product data for adhesives, grout and sealant in accordance with the General Administrative Requirements of the Construction Standards 01300.1.2. Maximum VOC content when calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168, effective July 1, 2005 and amended January 7, 2005:
  - 1. Adhesives 70 g/l

#### 1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide wall coverings and adhesives with the following fire-test-response characteristics as determined by testing identical products applied with identical adhesives to substrates per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Surface-Burning Characteristics: Class A, as follows, per ASTM E 84:
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.

## 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install wall coverings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

## PART 2 - PRODUCTS

### 2.1 WALL-COVERING PRODUCTS

- A. General: Provide rolls of each type of wall covering from the same run number or dye lot.

### 2.2 ACCESSORIES

- B. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application, as recommended in writing by wall-covering manufacturer.
- C. Primer/Sealer: Mildew resistant primer/sealer complying with requirements in Division 09 Section INTERIOR PAINTING and recommended in writing by wall-covering manufacturer for intended substrate.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- C. Comply with manufacturer's written instructions for surface preparation.
- D. Clean substrates of substances that could impair wall covering's bond, including mold, mildew, oil, grease, incompatible primers, dirt, and dust. Remove any existing wall coverings.
- E. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
  - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete and concrete masonry units when tested with an electronic moisture meter.
  - 2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity.
  - 3. Metals: If not factory primed, clean and apply metal primer.

4. Gypsum Board: Prime with primer recommended by wall-covering manufacturer.
5. Painted Surfaces: Treat areas susceptible to pigment bleeding.

- F. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.
- G. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- H. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.
- I. Install wall liner, with no gaps or overlaps, where required by wall-covering manufacturer. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.

### 3.3 INSTALLATION

- J. General: Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- K. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.
- L. Install strips in same order as cut from roll.
- M. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.
- N. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.
- O. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
- P. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.

### 3.4 CLEANING

- Q. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- R. Use cleaning methods recommended in writing by wall-covering manufacturer.
- S. Replace strips that cannot be cleaned.
- T. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 097200

## SECTION 099123 - INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 ISSUES

##### A. LEED

1. For paints and coatings applied on the interior of buildings and applied on-site maximum VOC shall be in accordance with Green Seal Standard GS-11, Paints, First Edition, May 20, 1993.
  - a. Flat paints and coatings: VOC content of not more than 50 g/L
  - b. Non-flat paints and coatings: VOC content of not more than 150 g/L
2. Anticorrosive and anti-rust paints shall meet requirements of Green Seal Standard GC-03, Anticorrosive Paints, Second Edition, January 7, 1997.
  - a. Anticorrosive coatings: VOC content of not more than 250 g/L
3. Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements shall meet requirements of South Coast Air Quality Management District (SCAQMD Rule #1113).
  - a. Varnish: VOC content of not more than 350 g/L
  - b. Lacquer: VOC content of not more than 550 g/L
  - c. Floor coatings: VOC content of not more than 100 g/L
  - d. Shellacs (clear): VOC content of not more than 730 g/L
  - e. Shellacs (pigmented): VOC content of not more than 550 g/L
  - f. Stains: VOC content of not more than 550 g/L
  - g. Sealers (waterproofing sealers): VOC content of not more than 250 g/L
  - h. Sealers (sanding sealers): VOC content of not more than 275 g/L
  - i. Sealers: (other than above listed) VOC content of not more than 200 g/L
4. Paints and coatings shall have a maximum of 1.0% of Total Aromatic Compounds (hydrocarbon compounds containing one or more benzene rings).
5. Paints and coatings shall not contain any of the following:
  - a. Acrolein
  - b. Acrylonitrile
  - c. Antimony
  - d. Benzene
  - e. Butyl benzyl phthalate
  - f. Cadmium
  - g. Di(2-ethylhexyl) phthalate
  - h. Di-n-butyl phthalate
  - i. Di-n-octyl phthalate
  - j. 1,2-dichlorobenzene
  - k. Diethyl phthalate
  - l. Dimethyl phthalate
  - m. Ethylbenzene
  - n. Formaldehyde
  - o. Hexavalent chromium
  - p. Isophorone



- q. Lead
- r. Mercury
- s. Methyl ethyl ketone
- t. Methyl isobutyl ketone
- u. Methylene chloride
- v. Napthalene
- w. Toluene (methylbenzene)
- x. 1,1,1-trichloroethane
- y. Vinyl chloride

B. Painting is not required on pre-finished items, finished metal surfaces, concealed surfaces, operating parts, and labels.

1. Pre-finished items NOT to be painted include the following factory-finished components:
  - a. Metal toilet enclosures
  - b. Acoustic materials
  - c. Architectural woodwork and casework
  - d. Elevator entrance doors and frames
  - e. Elevator equipment
  - f. Finished mechanical and electrical equipment
  - g. Light fixtures
  - h. Switchgear
2. Concealed surfaces NOT to be painted include wall or ceiling surfaces in the following generally inaccessible areas:
  - a. Foundation spaces
  - b. Furred areas
  - c. Utility tunnels
  - d. Pipe spaces
  - e. Duct shafts
  - f. Elevator shafts
  - g. Mechanical rooms
3. Operating parts NOT to be painted include moving parts of operating equipment such as the following:
  - a. Valve and damper operators
  - b. Linkages
  - c. Sensing devices
  - d. Motor and fan shafts
4. Finished metal surfaces NOT to be painted include:
  - a. Anodized aluminum
  - b. Stainless steel
  - c. Chromium plate
  - d. Copper
  - e. Bronze
  - f. Brass
  - g. Galvanized steel (unless specifically designated to be painted)

5. Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating or nomenclature plates.
- C. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and ironwork, and primed metal surfaces of mechanical and electrical equipment, in interior finished spaces only. Refer to Division 21 for additional fire protection painting requirements. Access panel covers must be painted separately, according to the following code: Electrical – orange, Communications – blue, Alarms – red.
- D. Paint exposed surfaces whether or not colors are designated in paint schedules, except where a specific designation indicates the surface or material is not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the project representative will select from standard colors or finishes available.

## 1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
  1. Concrete.
  2. Concrete masonry units (CMU).
  3. Steel.
  4. Galvanized metal.
  5. Aluminum (not anodized or otherwise coated).
  6. Wood.
  7. Gypsum board.
  8. Plaster.
  9. Cotton or canvas insulation covering.
- B. Surface preparation, priming and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.
- C. Related Sections include the following:
  1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
  2. Division 08 Sections for factory priming windows and doors with primers specified in this Section.
  3. Division 09 Section EXTERIOR PAINTING for surface preparation and the application of paint systems on exterior substrates.
  4. Division 21 Section WET-PIPE SPRINKLER SYSTEMS for fire protection painting.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, submitted to the Project Representative prior to project inception. List each material by the manufacturer's catalog number and general classification. The University retains the right to approve or disapprove any proposed equivalent paint products.
  1. Submit printed VOC statements.
  2. Submit printed aromatic compound statements.

3. Submit printed statements demonstrating that no restricted compounds are used.
- B. Samples for initial color selection: in the form of manufacturer's color charts. After color selection, the project representative will furnish color chips for surfaces to be coated. It is the contractor's responsibility to provide the project representative with three draw downs of each product and color combination to be used for final approval.
- C. Samples for Verification, when requested: For each type of paint system and each color and gloss of topcoat indicated.
  1. Submit Samples on rigid backing, 8 inches square.
  2. Step coats on Samples to show each coat required for system.
  3. Label each coat of each Sample.
  4. Label each Sample for location and application area.
- D. An actual color sample, 4' X 4', shall be painted on one wall of the jobsite for verification of actual wall color prior to any other painting. Actual color samples of other selected paints shall be painted on appropriate surfaces for verification as directed by the project representative.
- E. project representative.
- F. Product List: For each product indicated, include the following:
  1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
  1. Product name or title of material.
  2. Product description (generic classification or binder type).
  3. Federal Specification number, if applicable
  4. Manufacturer's stock number and date of manufacture.
  5. Thinning instructions.
  6. Application instructions.
  7. Color name and number.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperature continuously maintained at not less than 45 deg F.
  1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Keep storage area neat and orderly. Remove rags and waste from storage areas daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards from handling, mixing and application.
  3. Paint/varnish removers shall be non-flammable.

#### 1.5 PROJECT CONDITIONS

- A. Apply water based paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 90 deg F.

- B. Apply solvent-thinned paints only when temperature of surfaces to be painted and ambient air temperatures are between 45 and 95 deg F.
- C. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. The Glidden Co./PPG
  - 2. O'Leary Paints (O'Leary
  - 3. Sherwin-Williams Company (The).
  - 4. Benjamin Moore & Co.
  - 5. PPGIf products by manufacturers not listed above are recommended, they must be approved. at least 2 weeks prior to bidding.

### 2.2 PAINT, GENERAL

- A. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

### 2.3 BLOCK FILLERS

- A. High Performance Latex Block Filler: Used for filling open textured interior and exterior concrete block, above grade, before application of topcoats. This material should not be used in areas that are subject to continuous high moisture conditions such as daily washing, etc.
  - 1. PPG: Devoe Bloxfill 4000-1000 Heavy Duty Acrylic Block Filler
  - 2. O'Leary Paints: C946-11 Industrial Latex Block Filler
  - 3. Sherwin-Williams Company (The): Heavy Duty Block Filler B42W46
  - 4. Benjamin Moore & Co.: 206 Super Spec Masonry 100% Acrylic Hi-Build Block Filler.
  - 5. PPG: Pitt-Glaze Interior/Exterior Block Filler 16-90
- B. Severe Duty Two Component Epoxy Block Filler: Epoxy block filler used for filling open textured interior concrete block, before the application of high performance top coats. This filler should be used in all high moisture areas such as kitchens, showers, animal rooms, custodial wash areas, etc.

1. Devoe Tru-Glaze 4015 H P water borne 4015-1000
2. O'Leary Paints: 138-111-138-251B Acrylic Epoxy Block Filler
3. Sherwin-Williams Company (The): B42-WA8 WA9 or W42200/B42V201-Cement Plex
4. Benjamin Moore & Co.: M31/M32 Acrylic Epoxy Block Filler
5. PPG: Amerlock 400 BF Two-component epoxy masonry block filler

C. METAL PRIMERS

- D. Synthetic Int., Rust-Inhibiting Acrylic Primer: Quick drying, rust-inhibiting primer for priming galvanized and ferrous and non-ferrous metal on the interior under acrylic paints and odorless alkyd semigloss or alkyd gloss enamels.

1. PPG: Devoe Devflex 4020 PF
2. O'Leary Paints: 36-11 180-11 Acrylic Metal Primer
3. Sherwin-Williams Company (The): ProCryl-B66-W310 G
4. Benjamin Moore & Co.: P04 Super Spec HP Acrylic Metal Primer
5. PPG: Pitt-Tech Interior/Exterior Primer/Finish DTM 90-712/912 Series

- E. Alkyd-Type Zinc Metal Primer: Primers used for priming galvanized and ferrous metals under acrylic or alkyd enamel finishes.

1. PPG: Pitt-Tech Interior/Exterior Primer/Finish DTM 90-712/912 Series
2. O'Leary Paints: 36-11 Acrylic Metal Primer
3. Sherwin-Williams Company (The): ProCryl B66-W310
4. Benjamin Moore & Co.: P04 Super Spec HP Acrylic Metal Primer

- F. Non-Ferrous Metal Primer: Bonding type primer used to prime interior non-ferrous metal surfaces:

1. PPG: Devoe Devflex 4020PF
2. O'Leary Paints: 182 Industrial Acrylic DTM
3. Sherwin-Williams Company (The): DTM Bonding Primer ProCryl B66-W310
4. Benjamin Moore & Co.: (N023) Fresh Start Acrylic Primer
5. PPG: Pitt-Tech Interior/Exterior Primer/Finish DTM 90-712/912 Series

2.4 WOOD PRIMERS

- A. Interior Latex Enamel Undercoat: Ready-mixed latex primer for use as an undercoat over wood and hardboard under latex enamel topcoat.

1. PPG/Glidden: Gripper Interior/Exterior Primer Sealer 3210
2. O'Leary Paints: L50 Block it
3. Sherwin-Williams Company (The): Pro Block B51-600
4. Benjamin Moore & Co.: (253) Super-Spec Latex Enamel Undercoater
5. PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921 Series

2.5 INTERIOR LATEX PRIMERS

- A. Interior 100% Acrylic Primer: Acrylic primer used on plaster under flat, semigloss and gloss finishes. This primer must be specifically designed for application to plaster, gypsum drywall, block and masonry surfaces and over all alkyd paints as primer for re-coat.

1. PPG/Glidden: Gripper Primer Sealer 3210-1200
2. O'Leary Paints: L50 Block-it Acrylic Wall Primer
3. Sherwin-Williams Company (The): Latex Primer A24W8300
4. Benjamin Moore & Co.: N023 Fresh Start Acrylic Primer
5. PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921 Series

- B. Wall-covering Primer: New drywall and plaster surfaces that are to receive a wall-covering finish are to be primed with heavy-duty acrylic primer to allow easy stripping of wall-coverings off of surfaces.

1. PPG/Glidden: Vapor Barrier Interior Primer Sealer 1060-1200
2. O'Leary Paints: Ultra-Prep L-490
3. Sherwin-Williams Company (The): Pre Wallcovering Primer B28W8980
4. Benjamin Moore & Co.: (N023) Fresh Start Acrylic Primer Sealer
5. PPG: Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921 Series

## 2.6 INTERIOR LATEX PAINTS

- A. Interior/Exterior Acrylic Machinery Enamel Gloss: Premium quality gloss 100% acrylic enamel for use on interior and exterior metal and concrete surfaces where abrasion is a problem. This product shall have excellent adhesion characteristics even to existing alkyd finish coats and provide a smooth brush-mark free surface. TO BE USED ON METAL DOORS AND FRAMES. Use deep base and ultra deep base in the same product line.

1. PPG: Devoe DevFlex 4208
2. O'Leary Paints: L-8000 Duramax Acrylic Gloss
3. Sherwin-Williams Company (The): DTM Gloss B66W111
4. Benjamin Moore & Co.: P28 DTM Gloss
5. PPG: Pitt-Tech Plus Interior/Exterior Gloss DTM 90-374 Series -or- Pitt-Tech Plus Interior/Exterior High-gloss DTM 90-1310- Series

- B. Interior/Exterior Acrylic Machinery Enamel Semi-Gloss: Premium quality semi-gloss 100% acrylic enamel for use on interior and exterior metal and concrete surfaces where abrasion is a problem. This product shall have excellent adhesion characteristics even to existing alkyd finish coats and provide a smooth brush-mark free surface. TO BE USED ON METAL DOORS AND FRAMES. Use deep base and ultra deep base in the same product line.

1. PPG: Devoe Devflex 4216 HP Acrylic DTM Semi-Gloss
2. O'Leary Paints: L 9000 Duramax Acrylic Semi-Gloss
3. Sherwin-Williams Company (The): DTM Semi-Gloss B66W211
4. Benjamin Moore & Co.: P29 Semi
5. Pitt-Tech Plus Int./Ext. Semi-gloss DTM Industrial Enamel 90-1210 Series

- C. Acrylic DTM Semi-Gloss: Weather resistant, exterior acrylic semi-gloss for use on metal ducts, galvanized metals and ferrous and non-ferrous. Use deep base and ultra deep base in the same product line.

1. PPG: Devoe DevFlex 4216 HP Acrylic DTM Semi-Gloss
2. O'Leary Paints: 182 Industrial Acrylic DTM Semi G
3. Sherwin-Williams Company (The): DTM Acrylic Semi-Gloss B66W211
4. Benjamin Moore & Co.: P29 DTM Semi
5. Pitt-Tech Plus Int./Ext. Semi-gloss DTM Industrial Enamel 90-1210 Series

- D. Latex Based Interior Semi-Gloss Latex Enamel: Low odor 100% acrylic or modified styrene acrylic, (NO VINYL ACRYLIC) latex enamel for use as a semi-gloss finish over primed concrete, concrete block, wood, plaster, and gypsum drywall. This product shall have abrasion resistance at least equal to 100% of the Leneta "C" Panel when tested in accordance with ASTM D2486. Use deep base and ultra deep base in the same product line.
1. PPG/Glidden: Diamond Semi-Gloss 7400
  2. O'Leary Paints: L-2607 Pro-Tech Interior Latex Semi Gloss
  3. Sherwin-Williams Company (The): Solo A76W53 100% Acrylic Semi-Gloss  
(Deep Base) 0 VOC B66-W663  
(Ultra Deep Base) 0 VOC B66-T664
  4. Benjamin Moore & Co.: N376 Eco Spec WB Acrylic Semi Gloss
  5. PPG: Manor Hall Interior Semi-gloss 82-500 Series
- E. Latex Based Interior Eggshell Enamel: Low odor 100% acrylic or modified styrene acrylic, (NO VINYL ACRYLIC) latex enamel for use as an eggshell finish over primed concrete, concrete block, wood, plaster, and gypsum drywall. This product shall have abrasion resistance at least equal to 75% of the Leneta "C" Panel when tested in accordance with ASTM D2486. Use deep base and ultra deep base in the same product line.
1. PPG/Glidden: Diamond Eggshell 7200
  2. O'Leary Paints: L-1007 Interior Latex Eggshell
  3. Sherwin-Williams Company (The): Solo A75W53 100% Acrylic Eggshell  
(Deep Base) 0 VOC B66-W663  
(Ultra Deep Base) 0 VOC B66-T664
  4. Benjamin Moore & Co.: N374 Eco Spec WB Acrylic Egg Shell
  5. PPG: Manor Hall Interior Eggshell 82-300 Series
- F. Latex Based Interior Flat Paint: Ready mixed, latex based paint for use over primed concrete, concrete block, wood, plaster, and gypsum drywall, acoustical plaster surfaces and as a "size" on cotton or canvas covering over insulation, and on all ceilings. Use deep base and ultra deep base in the same product line.
1. PPG/Glidden: Diamond Flat 7100
  2. O'Leary Paints: 1400 Flat Ceramic Coat Latex Flat
  3. Sherwin-Williams Company (The): Solo Flat 100% Acrylic A74W51
  4. Benjamin Moore & Co.: N373 Eco Spec WB Acrylic Flat
  5. PPG: Manor Hall Interior Flat 82-100 Series

## 2.7 INTERIOR EPOXY FINISHES

- A. Acrylic Epoxy Gloss: Catalyzed acrylic epoxy gloss for use in areas of very high abrasion or where repetitive cleaning will be necessary.
1. O'Leary Paints: 138-1 Acrylic Epoxy Gloss G
  2. Sherwin-Williams Company (The): B70W 211 B60 V-15, or Zero VOC WB Catalyzed Epoxy B73W311.
  3. Benjamin Moore & Co.: P43 Super Spec HP Acrylic Epoxy Gloss
- B. PPG: Pitt-Glaze WB Water-Borne Acrylic Epoxy 16-551 Series Polyamide Epoxy Gloss: Catalyzed polyamide epoxy gloss for use in areas where the maximum in abrasion, moisture and chemical resistance is required.
1. O'Leary Paints: 101 Polyamide Epoxy Gloss
  2. Sherwin-Williams Company (The): B62-W101-V60 V70 Polyamide Epoxy Gloss, or WB Tile Clad B73W111.
  3. Benjamin Moore & Co.: P36 Super Spec HP Acrylic Epoxy Gloss

4. PPG: Aquapon WB Water Base Epoxy 98-1 Series

## 2.8 INTERIOR WOOD FINISHING MATERIALS

- A. Oil-Type Interior Wood Stain: Slow-penetrating oil-type wood stain for general use on interior wood surfaces under varnishes or was finishes.
  1. PPG: Flood 1700 Wood Stain
  2. O'Leary Paints: Old Masters, Finishes or Decorators Stains
  3. Sherwin-Williams Company (The): Woodclassics 250 Stain A49 Series
  4. Benjamin Moore & Co.: None
  5. PPG: Deft Wood Stain
- B. Paste Wood Filler: Solvent based, air-drying, paste type wood filler for use on open grain wood on interior wood surfaces.
  1. O'Leary Paints: 50001 Old Master Wood Filler
  2. Sherwin-Williams Company (The): Sher-wood Fast-Dry Filler D70T1
  3. Benjamin Moore & Co.: (236) Benwood Paste Wood Filler
- C. Interior Waterborne Urethane Satin: Clear, non-yellowing, water thinned, urethane sating, with excellent abrasion and moisture resistance. This product for use on interior stained or natural finished woodwork.
  1. PPG: Wood Pride1802 Satin Urethane
  2. O'Leary Paints: A4700-270 Waterborne Urethane
  3. Sherwin-Williams Co. (The): Woodclassics Waterborne Polyurethane A-68 series V91
  4. Benjamin Moore & Co.: (N423) Stays Clear Acrylic Urethane
  5. PPG: Deft WB Poly Satin

## 2.9 SURFACE PREPARATION AGENTS: Paint and varnish removers shall be non-flammable.

- A. Oil and Grease Emulsifier: Oil and grease emulsifier for cleaning walls, ceilings floors and equipment.
  1. PPG: Devoe Devprep 88
  2. O'Leary Paints: Coronado 93-500
  3. Sherwin-Williams Company (The): Extra Muscle Cleaner
  4. Benjamin Moore & Co.: P83 Oil & Grease Emulsifier
  5. PPG: Duraprep Prep88 water-based alkaline cleaner
- B. Epoxy and Urethane Remover: For stripping old epoxy or urethane coatings from surfaces to be re-coated.
  1. O'Leary Paints: Star to Paste Stripper
  2. Sherwin-Williams Company (The): Savagran Super-Strip
  3. PPG: Duraprep Prep220 Commercial Coating Remover
- C. Rust Removal and Metal Pre-treatment: For use in converting rust oxide and treatment of metal to promote coating adhesion.
  1. O'Leary Paints: Coronado 93-300
  2. Sherwin-Williams Company (The): Macroproxy 920 Pre-Prime B58T101
  3. Benjamin Moore & Co.: None
  4. PPG: Amerlock Sealer penetrating epoxy primer sealer



- D. Concrete Etch: Concrete pre-treatment for use in removing the laitance and etching smooth concrete to improve coating adhesion.
1. O'Leary Paints: Coronado 93-400
  2. Sherwin-Williams Company (The): Startex Muriatic Acid
  3. Benjamin Moore & Co.: P85 Concrete Pre-treatment and Etch
  4. PPG: DuraPrep 100 Concrete Etch
- E. Rust Converter: For converting rust into a black protective film.
1. PPG: Devoe Preprime 167
  2. O'Leary Paints: Coronado 93-900
  3. Sherwin-Williams Company (The): Oshpo Rust Converter.
  4. Benjamin Moore & Co.: P85 Rust Converter

### 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 work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
  2. Masonry (Clay and CMU): 12 percent.
  3. Wood: 15 percent.
  4. Plaster: 12 percent.
  5. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

#### 3.2 PREPARATION

- A. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, electrical panel box doors and similar items already in place that 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.
  2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

- B. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing, replacing, and/or repainting, as acceptable to the project representative. Provide "Wet Paint" signs to protect newly painted finishes. At completion of construction activities of other trades, touch up and restore all damaged or defaced painted surfaces.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall onto wet, newly painted surfaces.
  - 2. Provide barrier coats over incompatible primers or remove and re-prime. Notify project representative in writing of problems anticipated with use of specified finish coat material with substrates primed by others.
- D. Cementitious Material Substrates: Remove dust, dirt, grease, oil, release agents, curing compounds, efflorescence, and chalk.
  - 1. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation. Use abrasive blast-cleaning methods if recommended by the paint manufacturer.
  - 2. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
  - 3. Clean concrete floors to be painted with a five percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, vacuum, rinse and allow drying before painting.
- E. Steel Substrates: Clean non-galvanized ferrous-metal surfaces that have been shop coated: remove oil, grease, dirt, loose mill scale and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush; clean with solvents recommended by the paint manufacturer, and touch-up with the same primer as the shop coat.
- F. Galvanized-Metal Substrates: Clean galvanized surfaces with non-petroleum-based solvents so the surface is free of oil and surface contaminants. Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints. If galvanized metal is chromate passivated ("bonderized") consult manufacturers for appropriate surface preparation and primers.
- G. Aluminum Substrates: Remove surface oxidation.
- H. 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.
  - 5. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately upon delivery.
  - 6. Stripping and refinishing existing wood doors, trim, etc.

- a. Contractors shall take care to achieve clean and clear surfaces that will take stain uniformly. In some instances bleaching of the wood may be necessary. All existing varnish and stripping residue shall be removed and the surface neutralized and sanded smooth to assure a smooth and uniform finish.
- I. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.
- J. Exterior Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
- K. Repainting: Prime coats may be omitted with the exception of patched or repaired areas that should be spot-primed to ensure a uniform finish. Special care should be taken in re-coating existing alkyd or epoxy surfaces to prevent inter-coat adhesion failures. Painting of patch and repair work shall be painted out to the nearest break line, including areas in corridors, as directed by the Project Representative.
- L. Paint: Carefully mix and prepare paint materials in accordance with manufacturer's directions. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials or residue. Stir material before application to produce a mixture of uniform density; stir as required during application. Remove any surface film and, if necessary, strain material before using. Do not stir surface film into material. Use only thinners approved by the paint manufacturer and only within recommended limits.
- M. Tinting: Where multiple coats of the same material are applied, tint undercoats to match the color of the finish coat, but in a sufficiently lighter shade to distinguish each separate coat.

### 3.3 APPLICATION

- A. Paint colors, surface treatments, and finishes are indicated in schedules. Provide finish coats that are compatible with primers used.
- B. Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted or finished and has not been primed by others. Re-coat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- C. Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer. Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- D. Apply paints according to manufacturer's written instructions. Use applicators and techniques best suited for paint and substrate indicated. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
- E. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required in order to produce an even, smooth surface in accordance with the manufacturer's directions. Sand lightly between each succeeding enamel or varnish coat.
- F. Apply first coat to surfaces that have been cleaned, pre-treated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

- G. The term "exposed surfaces" includes areas visible when a permanent or built-in fixture, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
- H. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
- I. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
- J. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
- K. All materials will be applied under adequate lighting, evenly spread and flowed on smoothly. Cut in sharp lines and color breaks.
  - 1. Pigmented (opaque) finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and overage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable.
  - 2. Transparent (clear) finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 INTERIOR PAINTING SCHEDULE

- A. Concrete and Masonry (other than Concrete Masonry Units):
  - 1. Semi-Gloss Latex Finish:
    - a. Two coats latex semi-gloss over a primer. This system for use on surfaces that are not subject to high abrasion or continuously moist conditions.
      - 1) Prime Coat: Interior 100% Acrylic Primer

- 2) Intermediate Coat: Latex Based Interior Semi-Gloss Latex Enamel
  - 3) Intermediate Coat: Latex Based Interior Semi-Gloss Latex Enamel
2. Polyamide Epoxy Gloss Finish:
- a. Two coats over epoxy sealer, total dry film thickness of the two finish coats not less than 4.0 total mils. This system to be used in all areas that are exposed to chemical attract, constant moisture or frequent washing.
    - 1) Prime Coat: Epoxy Sealer
    - 2) Intermediate Coat: Polyamide Epoxy Gloss
    - 3) Intermediate Coat: Polyamide Epoxy Gloss
- B. Concrete Masonry Units Substrates:
1. Semi-Gloss Latex Enamel Finish:
    - a. Two coats over block filler. This system for use on surfaces that are not subject to high abrasion or continuously moist conditions.
      - 1) Prime Coat: High Performance Latex Block Filler
      - 2) Intermediate Coat: Latex Based Interior Semi-Gloss Latex Enamel
      - 3) Topcoat: Latex Based Interior Semi-Gloss Latex Enamel
  2. Semi-Gloss Alkyd Enamel Finish:
    - a. Two coats over block filler with total dry film thickness not less than 3.5 mils, excluding the block filler.
      - 1) Prime Coat: High Performance Latex Block Filler
      - 2) Intermediate Coat: DTM Alkyd Semi-Gloss Enamel
      - 3) Topcoat: DTM Alkyd Semi-Gloss Enamel
  3. Polyamide Epoxy Gloss Finish:
    - a. Two coats over block filler, total dry film thickness of the two finish coats not less than 4.0 mils. This system to be used in all areas that are exposed to constant moisture or frequent washing.
      - 1) Prime Coat: Severe Duty Two Component Epoxy Block Filler
      - 2) Intermediate Coat: Polyamide Epoxy Gloss
      - 3) Topcoat: Polyamide Epoxy Gloss
- C. Ferrous (and Non-Ferrous, Galvanized, and Aluminum) Metal Substrates:
- a. Semi-Gloss Acrylic System
    - 1) Two coats over primer with total dry film thickness not less than 2.5 mils.
      - a) Prime Coat: Acrylic Zinc Metal Primer
      - b) First Coat: DTM Acrylic Semi-Gloss Enamel
      - c) Second Coat: DTM Acrylic Semi-Gloss Enamel
- D. Gypsum Drywall Systems:

1. Lusterless (Flat) Emulsion System
  - a. Two coats. Flat latex finish with good washability and excellent touch-up characteristics. This system to be used only on ceilings, or on wall surfaces that are above eight feet high.
    - 1) Prime Coat: Interior 100% Acrylic Primer
    - 2) Topcoat: Latex Based Interior Flat Paint
2. Latex Interior Eggshell System
  - a. Two coats over primer
    - 1) Prime Coat: Interior 100% Acrylic Primer
    - 2) Intermediate Coat: Latex Based Interior Eggshell Enamel
    - 3) Topcoat: Latex Based Interior Eggshell Enamel
3. Latex Interior Semi-Gloss System
  - a. Two coats over primer
    - 1) Prime Coat: Interior 100% Acrylic Primer
    - 2) Intermediate Coat: Latex Based Interior Semi-Gloss Latex Enamel
    - 3) Topcoat: Latex Based Interior Semi-Gloss Latex Enamel
4. Odorless Acrylic Enamel Semi-Gloss System
  - a. Three coats with total dry film thickness not less than 2.5 mils.
    - 1) Prime Coat: Interior 100% Acrylic Primer
    - 2) Intermediate Coat: DTM Acrylic Semi-Gloss Enamel
    - 3) Topcoat: DTM Acrylic Semi-Gloss Enamel
5. Polyamide Epoxy Gloss System
  - a. Two coats over Interior 100% Acrylic Primer, total dry film thickness of the two finish coats not less than 2.5 mils. This system to be used for drywall and plaster surfaces that are exposed to constant moisture or frequent washing.
    - 1) Prime Coat: Interior 100% Acrylic Primer
    - 2) Intermediate Coat: Polyamide Epoxy Gloss
    - 3) Topcoat: Polyamide Epoxy Gloss

E. Plaster Systems:

1. Lusterless (Flat) Emulsion System
  - a. Two coats. Flat latex finish with good washability and excellent touch-up characteristics. This system to be used only on ceilings, or on wall surfaces that are above eight feet high.
    - 1) Prime Coat: Interior 100% Acrylic Primer
    - 2) Finish Coat: Latex Based Interior Flat Paint

2. Latex Interior Eggshell System
    - a. Two coats over primer
      - 1) Prime Coat: Interior 100% Acrylic Primer
      - 2) Intermediate Coat: Latex Based Interior Eggshell Enamel
      - 3) Topcoat: Latex Based Interior Eggshell Enamel
  3. Latex Interior Semi-Gloss System
    - a. Two coats over primer
      - 1) Prime Coat: Interior 100% Acrylic Primer
      - 2) Intermediate Coat: Latex Based Interior Semi-Gloss Latex Enamel
      - 3) Topcoat: Latex Based Interior Semi-Gloss Latex Enamel
  4. Polyamide Epoxy Gloss System
    - a. Two coats over Interior 100% Acrylic Primer, total dry film thickness of the two finish coats not less than 4.0 mils. This system to be used for drywall and plaster surfaces that are exposed to constant moisture or frequent washing.
      - 1) Prime Coat: Interior 100% Acrylic Primer
      - 2) Intermediate Coat: Polyamide Epoxy Gloss
      - 3) Topcoat: Polyamide Epoxy Gloss
- F. Woodwork and Hardboard System:
1. Semi-Gloss Enamel Finish:
    - a. Three coats
      - 1) Undercoat: Acrylic Enamel Undercoat
      - 2) First Coat: DTM Acrylic Semi-Gloss Enamel
      - 3) Second Coat: DTM Acrylic Semi-Gloss Enamel
- G. Stained Woodwork System:
1. Three finish coats over stain
    - a. Stain Coat: Oil-Type Interior Wood Stain
    - b. First Coat: Interior Waterborne Urethane Satin
    - c. Second Coat: Interior Waterborne Urethane Satin
    - d. Third Coat: Interior Waterborne Urethane Satin
- H. Problem Areas:
1. Glazed Tile, Ceramic, Porcelain, Tile, Glass, and Marble
    - a. First Coat: Acrylic Bonding Primer
    - b. Second Coat and Top Coat (required): Use appropriate systems as specified.
  2. Damp Areas, Boiler Rooms, etc./ Pipes, Concrete, Walls, and Ceilings

- a. First Coat: Acrylic Moisture Bond Primer
  - b. Second Coat: Acrylic Moisture Bond Enamel
3. Commercial Kitchens, Public Restrooms, Animal Care Areas, Shower Rooms, etc. Areas where high abuse and daily cleaning occur.
- a. Primer/First Coat:
    - 1) Masonry surfaces: Severe Duty Two Component Epoxy Block Filler
    - 2) Plaster and Drywall Surfaces: Interior 100% Acrylic Primer
  - b. Second and third coats: Acrylic Epoxy Gloss or Polyamide Epoxy Gloss
4. Handicap ramps, steps, areas where anti-slip coatings may be required:
- a. Surface preparation: Acid-etch concrete if required. Prime if previously painted.
  - b. First Coat: Epoxy Modified Acrylic Anti-slip Coating
  - c. Second Coat: Epoxy Modified Acrylic Anti-slip Coating

END OF SECTION 099123



## SECTION 101100 - VISUAL DISPLAY SURFACES

### PART 1 - GENERAL

#### 1.1 ISSUES

- A. All classrooms, lecture auditoriums, meeting rooms, etc., will have a chalkboard and, when requested, a tackboard. Boards will generally be 48 inches high and as long as feasible. White marker boards may be substituted for chalkboards in departmental rooms at the request of the department.
- B. Lecture auditoriums and a selection of classrooms (minimum of one for each 25 rooms), shall have vertical sliding visual display boards to accommodate instructors who prefer not to erase their notes before the end of the class; and to provide wheelchair users access to more writing surface than can be displayed higher.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Chalkboards
  - 2. Markerboards.
  - 3. Tackboards.
  - 4. Sliding visual display units.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include motor capacities and individual panel weights for sliding visual display units.
- B. Samples for Verification: For each type of visual display surface indicated and as follows:
  - 1. Visual Display Surface: Not less than 8-1/2 by 11 inches, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
  - 2. Trim: 6-inch- long sections of each trim profile.
  - 3. Accessories: Full-size Sample of each type of accessory.
- C. Maintenance Data: For visual display surfaces to include in maintenance manuals.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-built visual display boards, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.

- B. Store visual display units vertically with packing materials between each unit.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
  - 1. Matte Finish: Low reflective; chalk wipes clean with dry cloth or standard eraser.
  - 2. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.
- B. Particleboard: ANSI A208.1, Grade 1-M-1.
- C. Fiberboard: ANSI A208.2, Grade MD.
- D. Vinyl Fabric: FS CCC-W-408, Type II, burlap weave; weighing not less than 13 oz./sq. yd.; with flame-spread index of 25 or less when tested according to ASTM E 84.
- E. Extruded Aluminum: ASTM B 221, Alloy 6063.

### 2.2 CHALKBOARD ASSEMBLIES

- A. Porcelain-Enamel Chalkboard Assembly: Balanced, high-pressure, factory-laminated chalkboard assembly of 3-ply construction consisting of backing sheet, core material, and 0.021 inch thick porcelain-enamel face sheet with matte finish.
  - 1. Color: Dark Green or Black.
  - 2. Available Manufacturers:
    - a. AARCO Products, Inc.
    - b. ADP/Lemco, Inc.
    - c. Best-Rite Manufacturing.
    - d. Claridge Products & Equipment, Inc.
    - e. Ghent Manufacturing Inc.
    - f. Greensteel, Inc.
    - g. Platinum Visual Systems; a division of ABC School Equipment, Inc.
    - h. PolyVision Corporation.
  - 3. Particleboard Core: 3/8 inch thick with 0.015-inch- thick aluminum sheet backing.
  - 4. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

### 2.3 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboard Assembly: Balanced, high-pressure, factory-laminated markerboard assembly of 3-ply construction consisting of backing sheet, core material, and 0.021-inch- thick porcelain-enamel face sheet with low-gloss finish.
  - 1. Color: White.

2. Available Manufacturers:
  - a. AARCO Products, Inc.
  - b. ADP/Lemco, Inc.
  - c. Best-Rite Manufacturing.
  - d. Claridge Products & Equipment, Inc.
  - e. Ghent Manufacturing Inc.
  - f. Greensteel, Inc.
  - g. Platinum Visual Systems; a division of ABC School Equipment, Inc.
3. Particleboard Core: 3/8 inch thick with 0.015-inch- thick aluminum sheet backing.
4. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

## 2.4 TACK ASSEMBLIES

- A. Available Manufacturers:
  - a. AARCO Products, Inc.
  - b. ADP/Lemco, Inc.
  - c. Best-Rite Manufacturing.
  - d. Claridge Products & Equipment, Inc.
  - e. Ghent Manufacturing Inc.
  - f. Greensteel, Inc.
  - g. Platinum Visual Systems; a division of ABC School Equipment, Inc.
- B. Vinyl-Fabric-Faced Tack Assembly: Vinyl fabric factory laminated to 7/16-inch-thick fiberboard backing. The fiberboard and vinyl faces will each have a Class A Fire Hazard Classification.

## 2.5 SLIDING VISUAL DISPLAY UNITS

- A. Vertical-Sliding Visual Display Units: Factory-fabricated units consisting of extruded-aluminum tubular frame, fixed rear visual display panel, and aluminum-framed vertical-sliding panels; designed for recessed mounting. Provide panels that operate smoothly without vibration or chatter.
  1. Available Manufacturers:
    - a. ADP/Lemco, Inc.
    - b. Claridge Products & Equipment, Inc.
    - c. Platinum Visual Systems; a division of ABC School Equipment, Inc.
    - d. PolyVision Corporation.
  2. Type: Tubular frame. Unit shall be designed to support panels independent of wall.
  3. Sliding Panels: Fabricated from not less than 3/8-inch- thick, kraft-paper honeycomb core; designed to be rigid and to resist warping.
    - a. Fabricate sliding panels with 0.021-inch uncoated thickness, porcelain-enamel face sheets.
  4. Hardware: Manufacturer's standard neoprene ball-bearing end rollers, four on each side of each sliding panel. Counterbalance each sliding panel with lead counterweights supported by steel aircraft cable over ball-bearing sheaves with removable cover plate for

access to counterweights. Provide rubber bumpers at top and bottom for each sliding panel.

## 2.6 CHALKBOARD, MARKERBOARD, AND TACKBOARD ACCESSORIES

- A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum. Top and edges shall be J mold trim, and the bottom shall be J mold trim on markerboards and J mold trim with a continuous integral tray on chalkboards.

## 2.7 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Visual Display Boards: Factory assemble visual display boards, unless otherwise indicated.
  - 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
- C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.
  - 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints.
  - 2. Provide manufacturer's standard vertical-joint spline system between abutting sections of chalkboards and markerboards.

## 2.8 ALUMINUM FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- D. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

- B. Examine walls and partitions for proper backing for visual display surfaces.
- C. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove dirt, scaling paint, projections, and depressions that will affect smooth, finished surfaces of visual display boards.
- B. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, and substances that will impair bond between visual display boards and surfaces.
  - 1. Seal wall surfaces indicated to receive visual display fabric.
- C. Prepare recesses for sliding visual display units as required by type and size of unit.

### 3.3 INSTALLATION, GENERAL

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
  - 1. Mounting Height: 34 inches above finished floor to bottom of unit.

### 3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY UNITS

- A. Visual Display Boards: Attach visual display boards to wall surfaces with concealed clips around the perimeter and with egg-size adhesive gobs at 12 inches o.c. horizontally and vertically in the field of the board and continuously along any butt joint seams.
- B. Sliding Visual Display Units: Install units in recessed locations and at mounting heights indicated. Attach to wall framing with fasteners at not more than 16 inches o.c.
  - 1. Adjust panels to operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

### 3.5 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 101100

## SECTION 102113 - TOILET COMPARTMENTS

### PART 1 - GENERAL

#### 1.1 ISSUES

- A. The standard partition is stainless steel, except in residence halls where phenolic core partitions are preferred.

#### 1.2 SUMMARY

- A. This Section includes phenolic core and stainless-steel units as follows:
  - 1. Toilet Enclosures: Ceiling hung.
  - 2. Entrance Screens: Ceiling hung.
  - 3. Urinal Screens: Wall hung.
- B. Related Sections include the following:
  - 1. Division 05 Section METAL FABRICATIONS for supports that attach ceiling-hung units to overhead structural system.
  - 2. Division 10 TOILET AND BATH ACCESSORIES for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples for Verification on Request: Of each type of color and finish required for units, prepared on 6-inch- square Samples of same thickness and material indicated for Work.

#### 1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.

### PART 2 - PRODUCTS

#### 2.1 METAL UNITS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. General Partitions Mfg. Corp.

2. Global Steel Products Corp.
3. Metpar Corp.
4. Bradley Corporation, Mills Partitions
5. Sanymetal; a Crane Plumbing Company.
6. Or other with prior approved.

B. Stainless-Steel Units: Facing sheets and closures fabricated from ASTM A 666, Type 304, stainless-steel sheet, leveled to stretcher-leveled flatness.

1. Stainless-Steel Facing Sheet Thicknesses: Specified thicknesses as follows:
  - a. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.050 inch.
  - b. Panels: Manufacturer's standard thickness, but not less than 0.0312 inch.
  - c. Doors: Manufacturer's standard thickness, but not less than 0.0312 inch.
  - d. Integral-Flange, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than 0.0312 inch.
2. Finish: No. 4 bright, directional polish on exposed faces. Exposed surfaces are protected from damage by application of strippable, temporary protective covering before shipment.

C. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets are pressure laminated to core material. Edges are tack-welded at 18-inch intervals and sealed with an interlocking molding a minimum of 0.329 inches thick. Exposed surfaces are free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections. Corners are sealed by welding. Exposed welds are ground smooth.

1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch for doors and panels and 1-1/4 inches for pilasters.
2. Grab-Bar Reinforcement: Provide concealed solid wood internal reinforcement for grab bars mounted on units.
3. Urinal-Screen Construction: Similar to panels, with integral full-height flanges for wall attachment, and maximum 1-1/4 inches thick.

D. Pilaster Sleeves (Caps): Stainless steel, ASTM A 666, Type 302 or 304, not less than 0.0312 inch specified thickness and 3 inches high, finished to match hardware.

## 2.2 PHENOLIC-CORE UNITS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Bobrick Washroom Equipment, Inc.
2. General Partitions Mfg. Corp.
3. Global Steel Products Corp.
4. Bradley Corporation, Mills Partitions
5. Metpar Corp.
6. Or other with prior approval.

B. Door, Panel and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with



eased and polished edges. Provide minimum 3/4-inch- thick doors and pilasters and minimum 1/2-inch- thick panels.

### 2.3 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
  - 1. Material: Chrome-plated, nonferrous, cast zinc alloy (zamac), Chrome-plated brass, or Stainless steel.
- B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

### 2.4 FABRICATION

- A. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.
- B. Doors: Unless otherwise indicated, provide 24-inch- wide in-swinging doors for standard toilet compartments and 36-inch-wide out-swinging doors with a minimum 32-inch-wide clear opening for compartments indicated to be accessible to people with disabilities.
  - 1. Hinges: Self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees; with nylon bushings and stainless steel pins, and that will allow for lifting for emergency unlatching.
  - 2. Latch and Keeper: Latches will be a slidebar design with a projected handle. Rotating or recessed handles are not acceptable. Provide 8" long by 1½" projection pull handle on inside of doors on barrier free stalls at 8 " from the latch edge and 32" above the floor.
  - 3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories. Install two hooks inside of doors on barrier free stalls, one at barrier free height, and the other at standard height.
  - 4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors
  - 5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:
  - a. Pilasters and Panels: 1/2 inch.
  - b. Panels and Walls: 1 inch.
- B. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.
- C. Wall-Hung Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

### 3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

## SECTION 102810 - TOILET AND BATH ACCESSORIES

### PART 1 - GENERAL

#### 1.1 ISSUES

- A. Mirrors will normally be provided at all lavatory locations. Provide full-length mirror on adjacent wall for wheelchair users. If the full-length mirror is the only mirror available for wheelchair users, it will be immediately adjacent to a lavatory.
- B. Soap dispensers and paper towel dispensers will be provided and installed by\_\_\_\_\_. unless otherwise approved. If an alternate paper towel dispenser is approved, it shall use the standard paper towel roll and be a two roll type.

#### 1.2 SUMMARY

- C. This Section includes the following:
  - 1. Washroom accessories.
  - 2. Shower room accessories.
- D. Related Sections include the following:
  - 1. Division 09 Section CERAMIC TILING for ceramic toilet and bath accessories.

#### 1.3 SUBMITTALS

- E. Product Data: For each type of product indicated. Include the following:
  - 1. Construction details and dimensions.
  - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Material and finish descriptions.
  - 4. Manufacturer's warranty.
- F. Samples: If requested, full size, for each accessory item to verify design, operation, and finish requirements.
- G. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated on Drawings.
- H. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.
- I. Warranties: Submit written special warranty as specified in this Section. Include contact information, description of coverage, and start date for each special warranty.

#### 1.4 QUALITY ASSURANCE

- J. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

- K. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### 1.5 COORDINATION

- L. 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.
- M. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.
- N. It is the intent that all toilet room accessories and their methods of installation shall meet the latest ICC/ANSI A117.1 standards to provide barrier free access and use by mobility and physically impaired users.

#### 1.6 WARRANTY

- O. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 15 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Brass: ASTM B 19 flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- D. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- E. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- F. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

#### 2.2 WASHROOM ACCESSORIES

- G. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. A & J Washroom Accessories, Inc.
  - 2. American Specialties, Inc.
  - 3. Bobrick Washroom Equipment, Inc.
  - 4. Bradley Corporation.

- H. Toilet Tissue (Roll) Dispenser.
1. Description: Double or triple roll locking type; type 304 stainless steel, # 4 finish as manufactured by Royce Rolls Ringer Co. Locks will be furnished by\_\_\_\_\_. See Standard Drawing 17-10815 – TRIPLE ROLL TOILET PAPER HOLDER.
- I. Waste Receptacle (Bobrick B275 or approved equal).
1. Description: Surface mounted stainless steel open type with removable heavy-duty vinyl liner.
- J. Grab Bar (Bobrick B6806 or approved equal)
1. Mounting: Flanges with concealed fasteners.
  2. Material: Stainless steel, 0.05 inch thick with smooth, No. 4, satin finish.
  3. Outside Diameter: 1-1/4 inches in women's toilet rooms, 1-1/2 inches in all other areas.
- K. Sanitary Napkin Dispenser (Bobrick B282-25 (surface mount)). No exceptions.
1. Type: Sanitary napkin and tampon.
  2. Operation: Single coin (25 cents) replaceable coin mechanism..
  3. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
  4. Lockset: Corbin cabinet locks..
- L. Sanitary-Napkin Disposal Unit (Bobrick B270 or approved equal).
1. Mounting: Surface mounted.
  2. Door or Cover: Self-closing disposal-opening cover with full-length piano hinge and convenient handle for easy use.
  3. Material and Finish: Stainless steel, No. 4 finish (satin).
- M. Mirror Unit (Bobrick B-2908 or approved equal)
1. Frame: Stainless-steel angle, 0.05 inch thick.
    - a. Corners: Welded and ground smooth.
  2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
    - a. Wall bracket of galvanized steel, equipped with concealed locking devices.

### 2.3 SHOWER ROOM ACCESSORIES

- N. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. A & J Washroom Accessories, Inc.
  2. American Specialties, Inc.
  3. Bobrick Washroom Equipment, Inc.
  4. Bradley Corporation.
- O. Shower Curtain Rod (Bobrick 6047 or approved equal):
1. Description: 1-1/4-inch OD; fabricated from nominal 0.05-inch- thick stainless steel.
  2. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.

3. Finish: No. 4 (satin).

P. Folding Shower Seat (Bobrick B-5181 or approved equal):

1. Configuration: Folding, reversible for left or right hand installation in the field.
2. Seat: One-piece, ½" thick, solid phenolic with matte-finish. Integral slots for water drainage.
3. Mounting Mechanism: Stainless steel, No. 4 finish (satin), self-locking.

## 2.4 FABRICATION

- Q. 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.
- R. Keys: All locks and keys to be provided by Key Shop.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a load in any direction of at least 250 lbf, when tested according to method in ASTM F 446.
1. Attach concealed anchors for masonry walls with toggle bolts.
  2. Bolt mounting plates to steel plate reinforcing in stud partitions, to expansion shields in concrete walls, to reinforcement in metal partitions, and to thru-bolts welded to back mounting plate, unless otherwise specified. Where back mounting plate on thru-bolts will be exposed to view, anchor the mounting plate to the wall with toggle bolts or concealed anchors.
  3. Install at 33" from the finished floor to the top of the bar.
- C. Mirrors:
1. Anchor wall hangers to wall with approved fasteners. Anchor frame to wall hangers with concealed setscrews.
  2. Lower edge of mirror will be installed no higher than 40" above the finished floor.
- D. Dispensers and Receptacles-General:
1. Screw cabinets of recessed units to wall recesses.
- E. Sanitary Napkin Dispensers:
1. In classroom, office, and laboratory type buildings, provide one surface mounted dispenser in one first floor women's room.
  2. In athletic facilities, team rooms, etc., provide one surface mounted dispenser in each women's room.

3. In public restrooms in auditorium and arena type buildings, provide one recessed dispenser in each women's room.
4. Install dispenser with coin slot and operating buttons or levers no higher than 40" above the finished floor.

F. Sanitary Napkin Receptacles:

1. Unless otherwise indicated, install one sanitary napkin receptacle in each toilet compartment in women's toilet rooms.
2. Install 20" from back of compartment with top at 29" above the finished floor.

G. Toilet Paper Holders:

1. Mounting height: 40 inches above finished floor and 9" in front of toilet.

H. Paper Towel Dispensers:

1. Install one dispenser per two lavatories. At least one towel dispenser will be immediately adjacent to the barrier free lavatory.
2. Install dispenser with operating crank at 40" above the finished floor.

I. Shower Accessories Mounting Heights:

1. Towel bars: 48 inches to center of bar.
2. Robe hooks: 60 inches to center of plate. In accessible shower, a second hook should be mounted at 40" to center of plate.
3. Curtain rods: 74 inches to center of rod.
4. Shower seat: 18 inches to top of seat in down position.

3.2 ADJUSTING AND CLEANING

- J. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- K. Remove temporary labels and protective coatings.
- L. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102810

## SECTION 123410 – PLASTIC LAMINATE LABORATORY CASEWORK

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. ISSUES

1. Laboratory furniture shall be premium grade, conventional wall mounted units and floor mounted base units. All cabinetry shall be wood flush or flush-overlap construction, with all parts fabricated to insure uniformity and interchangeability. If matching existing casework or other concerns make wood or plastic-laminate casework more appropriate, they may be used with the approval. The manufacturer must have an assured delivery program for the specified type of furniture and related equipment and accessories.
2. Assemble and install furniture and tops in accordance to the manufacturer's directions. When assembled each cabinet shall be a complete and secure unit that will fit into an assembly of cabinets, and will permit a reorganization of components in the future. The countertops, utility chases, reagent shelves, and splashes shall form a complete working surface with all joints sealed and all components securely attached for a smooth, level and tight fit.
3. Verify locations of all cutouts prior to installation; coordinate work with electrical and plumbing trades. All electrical and plumbing services and fixtures shall be installed in conformance with the manufacturer's instructions, appropriate State codes, standard trade practices, and the direction of the Project Representative for a complete job.
4. In order for cabinets other than those listed in this standard to be approved, sufficient time must be provided for appropriate staff to review cabinet specifications and view a local site where the proposed cabinets have previously been installed.

##### B. This Section includes the following:

1. Plastic-laminate laboratory casework.
2. Laboratory countertops.
3. Laboratory sinks.

##### C. Related Sections include the following:

1. Division 11 Section LABORATORY FUME HOODS for fume hoods, including base cabinets and countertops under fume hoods.
2. Divisions 22 and 26 Sections for installing service fittings specified in this Section.
3. Division 12 Section METAL LABORATORY CASEWORK
4. Division 12 Section WOOD LABORATORY CASEWORK

#### 1.2 DEFINITIONS

##### A. Exposed Portions of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and visible surfaces in open cabinets or behind glass doors.

1. Ends of cabinets, including those installed directly against walls or other cabinets, shall be considered exposed.



- B. Semi-exposed Portions of Casework: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches or more above floor are defined as semi-exposed.
- C. Concealed portions of casework include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For plastic-laminate laboratory casework. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Indicate locations of blocking and reinforcements required for installing laboratory casework.
  - 2. Indicate locations and types of service fittings, together with associated service supply connection required.
  - 3. Include details of utility spaces showing supports for conduits and piping.
- C. Samples for Verification: On request, for each type of finish, including countertop material, in manufacturer's standard sizes.
- D. Qualification Data: For testing agency.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework finishes and countertops with requirements specified for chemical and physical resistance.

### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain laboratory casework, including countertops, sinks, service fittings, and accessories, through one source from a single manufacturer.
- B. Product Standard: Comply with SEFA 8, "Laboratory Furniture--Casework, Shelving and Tables--Recommended Practices."
- C. Flammable Liquid Storage: Where cabinets are indicated for solvent or flammable liquid storage, provide units that are listed and labeled as complying with requirements of NFPA 30 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Cabinets that are not listed and labeled but are constructed according to NFPA 30, Paragraph 4-3.3(c) may be used if acceptable to authorities having jurisdiction.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic-laminate laboratory casework until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Plastic-Laminate-Faced Casework:
    - a. Case Systems Inc.
    - b. LSI Corporation of America, Inc.
    - c. TMI Systems Design Corp.
    - d. Or as approved.

2.2 CABINET MATERIALS

- A. General:
  - 1. Hardwood Plywood: HPVA HP-1, either veneer core or particle core, unless otherwise indicated.
  - 2. Particleboard: ANSI A208.1, Grade M-2.
  - 3. Medium-Density Fiberboard: ANSI A208.2, Grade MD.
  - 4. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
  - 5. Edge banding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere.
- B. Exposed Materials:
  - 1. Plastic Laminate: Type VGS.
- C. Semi-exposed Materials:
  - 1. Plastic Laminate: Type VGS.
  - 2. Metal for Steel Drawer Pans: Cold-rolled, carbon-steel sheet complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.
- D. Concealed Materials:

1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility.
  2. Plywood: Hardwood plywood.
  3. Plastic Laminate: Type BKL.
  4. Particleboard.
  5. Medium-density fiberboard.
  6. Hardboard: AHA A135.4, Class 1 tempered.
- E. Acid Storage-Cabinet Lining: 1/4-inch- thick, polyethylene, polypropylene, epoxy, or phenolic-composite lining material.
- F. Glass for Glazed Doors: Clear laminated glass complying with ASTM C 1172, Kind LT, Condition A, Type I, Class I, Quality q<sup>3</sup>; with 2 lites not less than 3.0 mm thick and with clear, polyvinyl butyral interlayer.

### 2.3 CABINET FABRICATION

- A. Construction: Provide plastic-laminate-faced laboratory casework of the following minimum construction:
1. Bottoms and Ends of Cabinets, Shelves, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch- thick particleboard, plastic-laminate faced.
  2. Backs of Cabinets: 1/2-inch- thick particleboard, plastic-laminate faced.
  3. Drawer Fronts: 3/4-inch- thick particleboard, plastic-laminate faced on both sides.
  4. Drawer Sides and Backs: 1/2-inch- thick solid wood or plywood, with glued dovetail or multiple-dowel joints.
  5. Drawer Bottoms: 1/4-inch- thick plywood glued and dadoed into front, back, and sides of drawers. Use 1/2-inch- thick material for drawers more than 24 inches in width.
  6. Doors 48 Inches or Less in Height: 3/4 inch thick, with particleboard or medium-density fiberboard cores, solid wood stiles and rails, and plastic-laminate faced on both sides.
  7. Doors More Than 48 Inches in Height: 1-1/8 inches thick, with particleboard cores, plastic-laminate faced on both sides.
  8. Stiles and Rails of Glazed Doors: 3/4-inch- thick particleboard, plastic-laminate faced on both sides.
- B. Leg Shoes: Vinyl or rubber, black, open-bottom type.
- C. Utility-Space Framing: Laboratory casework manufacturer's standard steel framing units consisting of 2 steel slotted channels complying with MFMA-2, not less than 1-5/8 inches square by 0.0966 inch thick, and connected together at top and bottom by U-shaped brackets made from 1-1/4-by-1/4-inch steel flat bars. Framing units may be made by welding specified channel material into rectangular frames instead of using U-shaped brackets.
- D. Filler Strips and Utility-Space Closure Panels: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinet fronts.

### 2.4 CABINET HARDWARE

- A. General: Provide laboratory casework manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

- B. Hinges: Stainless steel, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 for doors 48 inches or less in height and 3 for doors more than 48 inches in height.
- C. Pulls: Stainless steel, fastened from back with two screws. For sliding doors, provide stainless steel recessed flush pulls. Provide 2 pulls for drawers more than 24 inches in width.
- D. Door Catches: Nylon-roller spring catch with stainless steel strike, and rubber stops. Provide 2 catches on doors more than 48 inches in height.
- E. Drawer Slides: Full suspension steel channels and runners, with minimum four ½ inch diameter nylon rollers; automatic positive cushioned stops; easy drawer removal, rebounding prevention springs; drawer front rubber bumpers.
- F. Locks: Manufacturer's standard lockset with Best core, or Best lockset.
- G. Sliding-Door Hardware Sets: Laboratory casework manufacturer's standard, to suit type and size of sliding-door units.

## 2.5 COUNTERTOPS AND SINKS

- A. Plastic-Laminate Countertops and Shelves:
  - 1. Countertops: Plastic-laminate sheet, complying with NEMA LD 3, shop bonded with waterproof adhesive to both sides of 3/4-inch-thick core. Sand surfaces to which plastic laminate is to be bonded.
  - 2. Plastic-Laminate Type for Flat Countertops: HGS.
  - 3. Plastic-Laminate Type for Shelves: HGL.
  - 4. Plastic-Laminate Type for Backing: BKL.
  - 5. Countertop Core: Particleboard complying with ANSI A208.1, Grade M-2.
  - 6. Adhesive for Bonding Plastic Laminate: Urea-formaldehyde.
  - 7. Finish front edges of countertops, faces and top edges of backsplashes and end splashes, and ends of countertops and splashes with same plastic laminate as top.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of plastic-laminate laboratory casework.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF CABINETS

- A. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

- B. Base Cabinets: Adjust top rails and subtops within 1/16 inch of a single plane. Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions with fasteners spaced not more than 24 inches o.c. Fasten adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
  - 1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches o.c. and at sides of cabinets with not less than 2 fasteners per side.
- C. Wall Cabinets: Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches o.c. Align similar adjoining doors to a tolerance of 1/16 inch.
- D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- E. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

### 3.3 INSTALLATION OF COUNTERTOPS

- A. Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints only where shown on Shop Drawings.
- B. Field Jointing: Where possible, make in the same manner as shop jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop.
  - 1. Use concealed clamping devices for field joints in plastic-laminate countertops. Locate clamping devices within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a uniform heavy pressure at joints.
- C. Fastening:
  - 1. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches o.c.
  - 2. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.
- D. Provide required holes and cutouts for service fittings.
- E. Provide scribe moldings for closures at junctures of countertop, curb, and splash, with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
- F. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

3.4 INSTALLATION OF SERVICE FITTINGS

- A. Comply with requirements in Divisions 22 and 26 Sections for installing water and laboratory gas service fittings, piping, electrical devices, and wiring.

3.5 CLEANING AND PROTECTING

- A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at minimum of 48 inches o.c.

END OF SECTION 123410

## SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
- .
6. Supports and anchorages.

#### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- D. The following are industry abbreviations for plastic materials:
  1. CPVC: Chlorinated polyvinyl chloride plastic.
  2. PE: Polyethylene plastic.
  3. PVC: Polyvinyl chloride plastic.
- E. The following are industry abbreviations for rubber materials:
  1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Escutcheons.
- B. Welding certificates.
- C. Certificate of Acceptance: Provide certificate as described in this section.

#### 1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- D. Permits and Inspections
  - 1. The Plumbing Contractor shall obtain and pay for all permits required by the State of Michigan Department of Licensing and Regulatory Affairs, Plumbing Division.
  - 2. The Plumbing Contractor shall submit, to precede request for final payment, a copy of the Certificate of Acceptance of the plumbing systems.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### 1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.



- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate systems shutdown (water, fire protection, hot water heating, steam, chilled water, etc.) with Project Representative. Activation and shut down of existing systems shall be conducted by personnel only.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### 2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASTM A-354 Grade BD and SAE J-429 Grade 8 for steam and condensate application, and ASTM A-354 and SAE J-429 Grade 5 for other low service temperature applications, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys, 95/5 tin-copper. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
  - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 2. CPVC Piping: ASTM F 493.
- H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.
- I.

## 2.4 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 2.5 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, no staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### 3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections. T-drill system for mechanically formed tee connections and couplings, and Victaulic hole cut piping system are not allowed.
- J. Install piping to allow application of insulation.
- K. Piping shall not project beyond walls or steel lines nor shall it hang below slabs more than is absolutely necessary. Particular attention shall be paid to the required clearances.

- L. Offset piping where required to avoid interference with other work, to provide greater headroom or clearance, or to conceal pipe more readily. Offsets shall be properly drained or trapped where necessary.
- M. Provide swing joints and expansion bends wherever required to allow the piping to expand without undue stress to connections or equipment.
- N. Isolate pipe from the building construction to prevent transmission of vibration to the structure and to eliminate noise.
- O. Exposed piping around fixtures or in other conspicuous places shall not show tool marks at fittings.
- P. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.
- Q. Select system components with pressure rating equal to or greater than system operating pressure.
- R. Eccentric reducing couplings shall be provided in all cases where air or water pockets would otherwise occur due to a reduction in pipe size. Eccentric couplings shall make the pipe flush on the top for water lines.
- S. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - f. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
  - 2. Existing Piping: Use the following:
    - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
    - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    - c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    - d. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
    - e. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
    - f. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

- T. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
1. Sleeves placed in floors shall be flush with the ceiling and shall have planed, square ends, extending 2 inches above the finished floor, unless otherwise specified or detailed.
  2. Where sleeves pass through reinforced concrete floors, they shall be properly set in position before the concrete is poured, and shall be maintained in position by the Contractor until the concrete is set.
  3. Sleeves placed in concrete beams shall be flush with the side of the beam and large enough to accommodate the bare pipe only. All other sleeves shall be of adequate size to accommodate pipe insulation undiminished in size.
  4. Pipes passing through above grade floor slabs and masonry walls shall have the space between the pipe or insulation and the sleeve packed with non-asbestos wicking or other suitable, approved, non-combustible material.
  5. Pipes passing through walls of Mechanical Equipment Rooms shall be made gas-tight by caulking the space between the pipe and sleeve with a fiber saturated with an approved type of plastic material.
- U. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
  3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- V. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- W. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- X. Verify final equipment locations for roughing-in.
- Y. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- Z. Return hot water line shall be no further than 15' from the fixture needing hot water.

### 3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

### 3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
- B. Unions shall be used in preference to couplings where their use will facilitate dismantling the pipe for maintenance.
- C. Install transition couplings at joints of dissimilar piping.
- D. No Uni-flange pipe adapters will be allowed.

### 3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 220500

## SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

### 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. Escutcheons.

#### 1.3 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

#### 1.4 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. BrassCraft Manufacturing Co.; a Masco company.
  - 2. Dearborn Brass.
  - 3.

#### 2.2 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

- E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

### 2.3 FLOOR PLATES

- A. Split Floor Plates: Cast brass with concealed hinge.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    - b. Chrome-Plated Piping: One-piece steel cast brass or split-casting brass with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece cast brass with finish.
    - d. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with finish.
    - f. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with finish.
  - 2. Escutcheons for Existing Piping to Remain:
    - a. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish
    - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

### 3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518



## SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

### 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. Brass ball valves.

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 and NSF 372.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, and soldered ends.
  - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded end valves.
  - 2. ASME B16.1 for flanges on iron valves.
  - 3. ASME B16.5 for flanges on steel valves.
  - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 5. ASME B16.18 for solder-joint connections.
  - 6. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves **NPS 4** and larger.
  - 2. Handlever: For quarter-turn valves smaller than **NPS 4**.
- H. Valves in Insulated Piping:
  - 1. Include **2-inch** stem extensions.
  - 2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
  - 3. Memory stops that are fully adjustable after insulation is applied.

### 2.2 BRASS BALL VALVES

- A. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Threaded or Soldered Ends:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. [Apollo Flow Controls; Conbraco Industries, Inc.](#)
    - b. [Milwaukee Valve Company.](#)
    - c. [NIBCO INC.](#)

2. Description:
  - a. Standard: MSS SP-110 or MSS SP-145.
  - b. CWP Rating: **600 psig**.
  - c. Body Design: Two piece.
  - d. Body Material: Forged brass.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel, vented.
  - i. Port: Full.

B. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. Milwaukee Valve Company.
  - c. NIBCO INC.
2. Description:
  - a. Standard: MSS SP-110 or MSS SP-145.
  - b. CWP Rating: Minimum **200 psig**.
  - c. Body Design: Two piece.
  - d. Body Material: Forged brass.
  - e. Ends: Press.
  - f. Press Ends Connections Rating: Minimum **200 psig**.
  - g. Seats: PTFE or RPTFE.
  - h. Stem: Stainless steel.
  - i. Ball: Stainless steel, vented.
  - j. Port: Full.
  - k. O-Ring Seal: Buna-N or EPDM.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

- E. Do not attempt to repair defective valves; replace with new valves.

### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

### 3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
  - 1. For Copper Tubing, **NPS 2** and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
  - 2. For Copper Tubing, **NPS 2-1/2 to NPS 4**: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 3. For Steel Piping, **NPS 2-1/2 to NPS 4**: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 4. For Steel Piping, **NPS 5** and Larger: Flanged ends.

### 3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe **NPS 2** and Smaller:
  - 1. Brass ball valves, two-piece with full port and stainless steel trim. Provide with threaded or solder-joint ends.
- B. Pipe **NPS 2-1/2** and Larger:
  - 1. Steel and Iron Valves, **NPS 2-1/2 to NPS 4**: May be provided with threaded ends instead of flanged ends.

END OF SECTION 220523.12

## SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### 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. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

- B. Related Sections:

1. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
2. Division 22 Section "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

#### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. Equipment supports.
- C. Welding certificates.

## 1.6 QUALITY ASSURANCE

- D. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- E. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Clevis.
  - 2. Fee and Mason.
  - 3. Anvil.
  - 4. PHD Manufacturing, Inc.

### 2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of hot dip galvanized or cadmium plated.
- B. Stainless-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

### 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### 2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. PHS Industries, Inc.
  - 2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa).
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa).
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

### 2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 2.6 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

### 2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- A. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- B. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- C. Install lateral bracing with pipe hangers and supports to prevent swaying.
- D. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65)



- and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- E. Holes shall not be drilled or punched in beams and supporting members. Do not support piping from roof deck, other piping, ducts or equipment.
  - F. Hangers and supports shall also be provided at every change of direction and within 1' of any pipe fittings and valves.
  - G. Pipe hangers in fan rooms and in mechanical equipment rooms shall be provided with suitable vibration isolation units to eliminate noise transmission between the piping and the building structure.
  - H. Hanger components shall not be used for purposes other than for which they were designed.
  - I. Vertical runs of piping not subject to appreciable expansion shall be supported by approved wrought steel clamps or collars, securely clamped to the risers. Where required, spring supports and guides shall be provided.
  - J. Where negligible movement of pipe occurs at hanger locations, rod hangers may be used for suspended lines. For piping supported from below, bases, brackets or structural cross members may be used.
  - K. If the vertical angle of the hanger is greater than 4 degrees, a traveling device shall be provided for horizontal movement. For piping supported from below, rollers or roller carriages shall be used.
  - L. Where significant vertical movement of the pipe occurs at the hanger location, a resilient support shall be used. Spring Cushion Hangers may be used where vertical movement does not exceed 1/4".
  - M. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
  - N. Riser Supports
    - 1. On a riser subject to expansion, only one support of the rigid type shall be used.
    - 2. Riser clamps shall have a positive means of engagement between the pipe and the clamp.
    - 3. Vertical runs of piping not subject to appreciable expansion shall be supported by approved wrought steel clamps or collars, securely clamped to the risers. Where required, spring supports and guides shall be provided.
  - O. Anchors, Guides and Restraints: Anchors, guides and restraints shall be provided wherever necessary to support risers, to maintain pipe in position, and to properly distribute expansion.
  - P. Supplemental Framing: Supplemental framing, angles, channels or beams, shall be provided where the anchor locations do not align with the building structure or where the intended loads exceed the structural framing maximum load carrying capacity.
  - Q. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- R. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- S. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
  4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
    - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
    - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
    - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
    - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
  5. Pipes NPS 8 (DN 200) and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
  6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- T. Plastic Pipe Hanger Installation:
1. Rigid plastic piping shall normally be supported by the same type of hangers used with steel pipe. In pressure application, hangers shall be provided with pads or cushions on the bearing surfaces.
  2. Flexible plastic tubing shall be supported continuously by metal angles or channels with special hangers.
- U. Polypropylene Pipe Hanger Installation: Support continuously between its hangers in either angle iron or sheet metal angles.

- V. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- W. Glass Piping Hanger Installation:
  - 1. Hangers shall be provided with pads or cushions on the bearing surfaces. Supports shall be as recommended by the pipe manufacturer.
  - 2. Hangers shall be placed approximately one foot from each side of fittings or couplings. At least two hangers shall be used for each 10-foot section.

### 3.2 EQUIPMENT SUPPORTS

- X. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- Y. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- Z. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 ADJUSTING

- AA. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- BB. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

### 3.4 HANGER AND SUPPORT SCHEDULE

- CC. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- DD. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- EE. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- FF. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- GG. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- HH. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- II. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- JJ. Use padded hangers for piping that is subject to scratching.
- KK. Use thermal-hanger shield inserts for insulated piping and tubing.

- LL. Use of "C" clamps and beam clamps of "C" pattern and any modifications thereof is prohibited.
- MM. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
  2. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
  3. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
  4. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  5. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
  6. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
  7. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  8. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  9. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- NN. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- OO. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
  2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
- PP. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Use of "C" clamps and beam clamps of "C" pattern and any modifications thereof is prohibited.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles. Use only when it is not possible to use center loading beam clamps. Subject to prior approval by the A/E.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  6. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  7. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
- QQ. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- RR. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- SS. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- TT. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

- UU. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- VV. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

## SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### 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

1. Pipe labels.
2. Stencils.
3. Valve tags.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

#### 1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  1. Marking Services Inc.
  2. Seton Name Plate Co.

## 2.2 EQUIPMENT LABELS

### A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

### B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
4. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

### C. Label Content: Include equipment's Drawing designation or unique equipment number.

### D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number. Equipment schedule shall be included in operation and maintenance data.

## 2.3 PIPE LABELS

### A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

### B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

### C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.



## 2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

## 2.5 VALVE TAGS

- A. Valve Tags: 1-1/2" diameter round with 3/16" top hole, stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
  - 1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: #16 solid brass jack chain.
  - 3. No painted tags will be accepted.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-tag schedule shall be included in operation and maintenance data.
- C. Number sequences shall be from 1 thru 999 with top line legends as follow:
  - 1. Domestic Cold Water CW
  - 2. Domestic Hot Water HW

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 PIPE LABEL INSTALLATION

- A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
7. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.

C. Pipe Label Legends:

1. General Services
  - a. Domestic Cold Water
  - b. Domestic Hot Water Supply
  - c. Vent
2. Special Services

3.3 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. All valves and regulators (except those directly serving equipment) shall be provided with a brass tag securely wired in place on the valve stem below the packing gland nut. Tags shall clearly indicate the part of system, or room name and/or number controlled by the valve.
- C. Furnish four (4) hot-press laminated typewritten copies of valve schedule, giving valve number controlled by the valve and location of valve. One copy will be mounted on a directory board in the main mechanical room, and one copy will be placed in each of the three mechanical brochures.
- D. Prepare separate directories and drawings for the plumbing, heating, and air conditioning systems showing system layout as installed, and giving the number, location, and purpose of each component. The Contractor shall contact the A/E before starting the directory to insure proper tagging and listing.
- E. Where it is necessary to operate more than one valve to control a section of piping, this fact and the numbers of the secondary valves shall be noted on the directory.

END OF SECTION 220553

## SECTION 220700 - PLUMBING INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Insulation Materials:
  - a. Cellular glass.
  - b. Flexible elastomeric.
  - c. Mineral fiber.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Field-applied jackets.
8. Tapes.
9. Securements.
10. Corner angles.

- B. Related Sections include the following:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 23 Section "HVAC Insulation."

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

- B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.

7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- D. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
  - 1. .
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Duct Wrap.
    - d. Owens Corning; All-Service Duct Wrap.
- H. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armacell LLC; Tubolit.
    - b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
- I. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed

0.26 Btu x in./h x sq. ft. x deg F (0.038 W/m x K) after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Dow Chemical Company (The); Styrofoam.
  - b. Knauf Insulation; Knauf Polystyrene.

## 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F (29 to plus 60 deg C).
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
  1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

## 2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

## 2.5 SEALANTS

- A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
4. Color: White or gray.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: Aluminum.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: White.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.  
B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Johns Manville; Zeston.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
5. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; Metal Jacketing Systems.
  2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
    - a. Finish and thickness are indicated in field-applied jacket schedules.
    - b. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
    - c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
    - d. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
  3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
    - a. Material, finish, and thickness are indicated in field-applied jacket schedules.
    - b. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
    - c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
    - d. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.



## 2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

## 2.9 SECUREMENTS

### A. Bands:

- 1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing or closed seal.
- 2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing or closed seal.
- 3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

### B. Insulation Pins and Hangers:

- 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
- 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
- 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
- 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
- 5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
- 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy or 0.062-inch (1.6-mm) soft-annealed, stainless steel.

## 2.10 CORNER ANGLES

- A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.
  - 5. Handholes.
  - 6. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."
3. .

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
  - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  - 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
  - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

- E. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  - 1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
  - 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
  - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- F. Where FSK (Foil Scrim Kraft) jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- G. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- H. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof

sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

### 3.8 FIELD QUALITY CONTROL

- I. Perform tests and inspections.
- J. Tests and Inspections:
  - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
  - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- K. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.9

#### 3.10 PIPING INSULATION SCHEDULE, GENERAL

- L. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- M. PVC jackets shall be installed on insulated piping in conjunction with fitting covers to provide a total sealed system as required by USDA and FDA for applications in food and pharmaceutical facilities.
- N. Insulate cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self sealing laps.
  - 1. Domestic cold water.

#### 3.11 INDOOR PIPING INSULATION SCHEDULE

- O. Domestic Cold Water:
  - 1. All pipe sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1 inch (25 mm) thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
    - c. Polyolefin: 1 inch (25 mm) thick.
- P. Domestic Hot and Recirculated Hot Water:
  - 1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be one of the following:

- a. Flexible Elastomeric: 1 inch (19 mm) thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (13 mm) thick.
  - c. Polyolefin: 1 inch (19 mm) thick.
2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1.5 inch (25 mm) thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1.5 inch (25 mm) thick.
    - c. Polyolefin: 1.5 inch (25 mm) thick.
- Q. Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1/2 inch (13 mm) thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.
    - c. Polyolefin: 1/2 inch (13 mm) thick.

3.13  
3.14

END OF SECTION 220700



## SECTION 220719 - PLUMBING PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Domestic recirculating hot-water piping.
  - 4. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
  - 1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at pipe expansion joints for each type of insulation.
  - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 4. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 5. Detail application of field-applied jackets.
  - 6. Detail application at linkages of control devices.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### 1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [Aeroflex USA, Inc.](#)
    - b. [Armacell LLC.](#)
- G. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [Johns Manville; a Berkshire Hathaway company.](#)
    - b. [Knauf Insulation.](#)
    - c. [Owens Corning.](#)
  - 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
  - 3. **850 deg F.**
  - 4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
  - 5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

### 2.2 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. [3M Industrial Adhesives and Tapes Division.](#)
    - b.
    - c. [Knauf Insulation.](#)
  - 2. Width: **3 inches.**
  - 3. Thickness: **11.5 mils.**

4. Adhesion: **90 ounces force/inch** in width.
5. Elongation: 2 percent.
6. Tensile Strength: **40 lbf/inch** in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

## 2.3 SECUREMENTS

### A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ITW Insulation Systems; Illinois Tool Works, Inc.
  - b. RPR Products, Inc.
2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; **0.015 inch** thick, **1/2 inch** wide with wing seal or closed seal.
3. Aluminum: **ASTM B209**, Alloy 3003, 3005, 3105, or 5005; Temper H-14, **0.020 inch** thick, **1/2 inch** wide with wing seal or closed seal.

## 2.4 PROTECTIVE SHIELDING GUARDS

### A. Protective Shielding Pipe Covers, :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Plumberex Specialty Products, Inc.
  - b. Truebro.
  - c. Zurn Industries, LLC.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

### B. Protective Shielding Piping Enclosures, :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Truebro.
  - b. Zurn Industries, LLC.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer **5 mils** thick and an epoxy finish **5 mils** thick if operating in a temperature range of between **140 and 300 deg F**. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between **32 and 300 deg F** with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

#### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
  - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with **3-inch-** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced **4 inches** o.c.
  - 3. Overlap jacket longitudinal seams at least **1-1/2 inches**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at **4 inches** o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches** beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.

3. Nameplates and data plates.
4. Cleanouts.

### 3.4 PENETRATIONS

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
  1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape

insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least **2 inches** over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at **6 inches** o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.



2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at **6 inches** o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless steel bands at **12-inch** intervals, and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least **3 inches**. Secure inner layer with **0.062-inch** wire spaced at **12-inch** intervals. Secure outer layer with stainless steel bands at **12-inch** intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at **6 inches** o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as

recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as that of pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.11 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with **2-inch** overlap at seams and joints.
  2. Embed glass cloth between two **0.062-inch-** thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with **1-1/2-inch** laps at longitudinal seams and **3-inch-** wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with **1-inch** overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with **2-inch** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands **12 inches** o.c. and at end joints.

### 3.12 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

- D. Do not field paint aluminum or stainless steel jackets.

### 3.13 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.14 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

### 3.15 INDOOR PIPING INSULATION SCHEDULE

#### A. Domestic Cold Water:

- 1. **NPS 1** and Smaller: Insulation shall be one of the following:
  - a. Flexible Elastomeric: **1/2 inch** thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch** thick.
- 2. **NPS 1-1/4** and Larger: Insulation shall be one of the following:
  - a. Flexible Elastomeric: **1 inch** thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.

#### B. Domestic Hot and Recirculated Hot Water:

- 1. **NPS 1-1/4** and Smaller: Insulation shall be one of the following:
  - a. Flexible Elastomeric: **3/4 inch** thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch** thick.
- 2. **NPS 1-1/2** and Larger: Insulation shall be one of the following:
  - a. Flexible Elastomeric: **1 inch** thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.

END OF SECTION 220719

## SECTION 221116 - DOMESTIC WATER PIPING

### 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. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
- 2. Encasement for piping.

##### B. Related Section:

- 1. Division 22 Section "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

#### 1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Construction Representative no fewer than seven days in advance of proposed interruption of water service.

2. Do not proceed with interruption of water service without Construction Representative's written permission.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

### 2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.
- C. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- D. Appurtenances for Grooved-End Copper Tubing:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International.
    - b. Grinnell Mechanical Products.
    - c. Shurjoint Piping Products.
    - d. Victaulic Company.
  2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
  3. Mechanical Couplings for Grooved-End Copper Tubing:
    - a. Copper-tube dimensions and design similar to AWWA C606.
    - b. Ferrous housing sections.
    - c. EPDM-rubber gaskets suitable for hot and cold water.
    - d. Bolts and nuts.
    - e. Minimum Pressure Rating: 300 psig (2070 kPa).
    - f.

#### 2.3.1 DUCTILE-IRON PIPE AND FITTINGS



- A. Mechanical-Joint, Ductile-Iron Pipe:
  - 1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Standard-Pattern, Mechanical-Joint Fittings:
  - 1. AWWA C110/A21.10, ductile or gray iron.
  - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Compact-Pattern, Mechanical-Joint Fittings:
  - 1. AWWA C153/A21.53, ductile iron.
  - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- D. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.
- E. Appurtenances for Grooved-End, Ductile-Iron Pipe:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Shurjoint Piping Products.
    - 2) Victaulic Company.
  - 2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions that match pipe.
  - 3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
    - a. AWWA C606 for ductile-iron-pipe dimensions.
    - b. Ferrous housing sections.
    - c. EPDM-rubber gaskets suitable for hot and cold water.
    - d. Bolts and nuts.

## 2.3 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe:
  - 1. ASTM A 53/A 53M, Type E, Grade B, Standard Weight.
  - 2. Include ends matching joining method.

- B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.
- C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- D. Malleable-Iron Unions:
  - 1. ASME B16.39, Class 150.
  - 2. Hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal, bronze seating surface
  - 4. Threaded ends.
- E. Flanges: ASME B16.1, Class 125, cast iron.
- F. Appurtenances for Grooved-End, Galvanized-Steel Pipe:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Anvil International.
    - 2) Grinnell Mechanical Products
    - 3) Shurjoint Piping Products.
    - 4) Victaulic Company.
  - 2. Fittings for Grooved-End, Galvanized-Steel Pipe: Galvanized, ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
  - 3. Fittings for Grooved-End, Galvanized-Steel Pipe:
    - a. AWWA C606 for steel-pipe dimensions.
    - b. Ferrous housing sections.
    - c. EPDM-rubber gaskets suitable for hot and cold water.
    - d. Bolts and nuts.
- G. Zinc used in galvanizing shall meet the requirements of ASTM B-6 and shall be applied using 2 ounces of zinc per square foot of coated surface.
- H. Reducing couplings, snap-joint couplings, and Vic-boltless couplings are not acceptable.
- I. Hole cut piping, pressfit, and plain end piping systems will not be accepted.
- J. Gasket material for water service up to 200 degree F shall be EPDM rubber, grade E.

## 2.4 STAINLESS-STEEL PIPE AND FITTINGS

- A. Stainless-Steel Pipe: Schedule 10S, ASTM A 312/A 312M, Type 304/304L, seamless or electric

- resistance welded pipe.
- B. Grooved-Joint Systems:
1. Manufacturers:
    - a. Anvil International, Inc.; Gruvlok Manufacturing; Model 7400SS.
    - b. Tyco Fire & Building Products; Grinnell Mechanical Products; Model 472.
    - c. Victaulic Company; Style 489.
    - d. Shurjoint Piping Products.
  2. Grooved-End, Stainless Steel-Piping Fittings: Schedule 10S, Type 304L or 316L stainless steel from material conforming to ASTM A 403 or pipe conforming to ASTM A 312, or sheet conforming to ASTM A 240; with dimensions matching stainless steel pipe.
  3. Grooved-End, Stainless Steel-Piping Couplings: ASTM A 743, cast Type 316L stainless steel, EPDM gaskets, and stainless steel bolts and nuts.
    - a. Rigid Type: To provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.
- C. Flanges: ASME B16.1, Classes 125 and 250, constructed of ASTM A 351, Type 304L stainless steel.

## 2.5 PEX TUBE AND FITTINGS

- A. PEX Distribution System: ASTM F 877, SDR 9 tubing.
- B. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.

## 2.6 PIPING JOINING MATERIALS

- A. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

## 2.7 ENCASUREMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: Sheet.
- C. Color: Black or natural.

## 2.8 TRANSITION FITTINGS

### A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

## 2.9 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

### 1. Manufacturers:

- a. Central Plastics Company.
- b. Watts Industries, Inc.; Water Products Div.
- c. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

### 1. Manufacturers:

- a. Central Plastics Company.
- b. Watts Industries, Inc.; Water Products Div.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

### 1. Manufacturers:

- a. Lochinvar Corp.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

### 1. Manufacturers:

- a. Perfection Corp.; Clearflow Dielectric Waterway.
- b. Precision Plumbing Products, Inc.
- c. Sioux Chief Manufacturing Co., Inc.

- d. Victaulic Co. of America.

### PART 3 - EXECUTION

#### 3.1 PIPING INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic installation requirements.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install eccentric reducing couplings, flush on the top for water lines, where air or water pockets would otherwise occur due to a reduction in pipe size.
- D. Cap and plug all openings in pipes with suitable metal plugs or cap to keep out dirt and rubbish during construction until equipment is connected.
- E. Install domestic water piping level without pitch and plumb.
- F. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- G. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- H. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- I. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- J. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment. Use ball for piping NPS 6 and smaller. Use butterfly valves for piping NPS 8 and larger.
- K. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
- L. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop

flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

### 3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- F. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- G. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- H. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- I. Flanged Joints: Select appropriate asbestos-free gasket material, size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- J. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Piping: Join according to ASTM D 2855.

- K. Joints for PEX Piping: Join according to ASTM F 1807.
- L. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.3 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.

### 3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
1. NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.
  2. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric nipples.
  3. NPS 5 (DN 125) and Larger: Use dielectric flange kits.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
1. Vertical Piping: MSS Type 8 or 42, riser clamps.
  2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
  2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
  3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
  4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
  5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
  6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
  7. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- E. Install supports for vertical copper tubing every 10 feet (3 m).
- F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
  2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
  3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
  4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
  5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
  6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
  7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
  8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- G. Install supports for vertical steel piping every 15 feet (4.5 m).
- H. Install hangers for cast iron piping with the following horizontal spacing:
1. 10 feet maximum.
  2. Minimum of one hanger per pipe section close to joint on the barrel. Also at change of direction and branch connections.
- I. Install hangers for ductile iron piping with the following horizontal spacing:
1. 10 feet maximum.
  2. Minimum of one hanger per pipe section close to the joint behind the bell and at change of direction and branch connections.
- J. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.



- C. Pipe sizes indicated shall be carried full size to equipment served. Any change of size to match equipment connection shall be made within one foot of the equipment. At temperature control valves with sizes smaller than connected lines, reduction shall be made immediately adjacent to valves.
- D. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- E. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
  - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

### 3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
  - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow standing for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

- D. Domestic water piping will be considered defective if it does not pass tests and inspections.  
E. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
  - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
  - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.10 CLEANING

- A. All piping shall be cleaned before the installation, and flushed after the installation and before system startup.
- B. Equipment, detergents, solvents and other cleaning agents shall be furnished by a qualified water treatment services.
- C. Clean and disinfect potable domestic water piping as follows:
  - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- D. Clean non-potable domestic water piping as follows:
  - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- E. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- F. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.11 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Brazed joints may be used on aboveground copper tubing. Extruded-tee connections are prohibited.
- D. In-building-slab, domestic water, trap seal primer piping, NPS 1 (DN 25) and smaller, shall be the following:
  - 1. PEX tube, fittings for PEX tube, and crimped joints.
- E. Under-building-slab, domestic water, building service piping, NPS 2 and smaller, shall be the following:
  - 1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); copper pressure-seal fittings; and pressure-sealed joints.
- F. Under-building-slab, domestic water, building-service piping, NPS 2-1/2 and larger, shall be the following:
  - 1. Mechanical-joint, ductile-iron pipe; standard- or compact- pattern mechanical-joint fittings; and mechanical joints.
- G. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be the following:
  - 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought- copper solder-joint fittings; and soldered joints.
- H. Aboveground domestic water piping, NPS 2-1/2 and larger, shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); grooved-joint copper-tube appurtenances; and grooved joints.
  - 2. Stainless-Steel Pipe: Schedule 10S, ASTM A 312/A 312M, Type 304/304L; grooved-joint stainless steel appurtenances; and grooved joints.
- I. Aboveground, combined domestic-water-service and fire-service-main piping, NPS 5 (DN 125) and larger, shall be the following:
  - 1. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

### 3.12 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use ball valves for piping NPS 6 and smaller. Use butterfly valves with flanged ends for piping NPS 8 and larger.
  - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
  - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
  - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

## 6SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
  - 1. Vacuum breakers.
  - 2. Water hammer arresters.
  - 3. Air vents.
  - 4. Flexible connectors
- B. Related Sections include the following:
  - 1. Division 22 Section "Domestic Water Filtration Equipment" for water filters in domestic water piping.
  - 2. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.

#### 1.5 INFORMATION SUBMITTALS

- C. Field quality-control test reports.

#### 1.6 CLOSEOUT SUBMITTALS

- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

### 2.3 VACUUM BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Ames Co.
- b. Apollo Valves by Conbraco Industries, Inc.
- c. Conbraco Industries, Inc.
- d. FEBCO; SPX Valves & Controls.
- e. Sioux Chief.
- f. Watts Industries, Inc.; Water Products Div.
- g. Woodford Manufacturing Company.
- h. Zurn Plumbing Products Group; Wilkins Div.

- B. Beverage-Dispensing-Equipment Backflow Preventers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Watts Industries, Inc.; Water Products Div.
- b. Zurn Plumbing Products Group; Wilkins Div.
- c. Apollo Valves by Conbraco Industries, Inc.
- d.

- 2. Standard: ASSE 1022.
- 3. Operation: Continuous-pressure applications.
- 4. Size: NPS 1/4 or NPS 3/8.
- 5. Body: Stainless steel.
- 6. End Connections: Threaded.

### 2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

- A. Primary, Thermostatic, Water Mixing Valves:
- B. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves by Conbraco Industries, Inc.
  - b. Leonard Valve Company.
  - c. Powers; a Watts Industries Co.; Hydroguard Series e480.
  - d. Symmons.
  - e. Apollo Valves by Conbraco Industries, Inc.
2. Standard: ASSE 1016/1070, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Solid brass construction with corrosion-resistant interior components.
5. Temperature Control: Adjustable temperature selection with locknut to prevent tampering.
6. Inlets and Outlet: Threaded. Integral checks on inlets.

## 2.5 STRAINERS FOR DOMESTIC WATER PIPING

### A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size: 0.094 inch.
6. Drain: Pipe plug.

## 2.6 WATER HAMMER ARRESTERS

### A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. .
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.



## 2.7 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flex-Hose Co., Inc.
  2. Metraflex, Inc.
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: Minimum 250 psig (1725 kPa).
  2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
  3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 250 psig (1725 kPa).
  2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
  3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Install in an accessible location to facilitate testing and servicing with the height between 12" and 60" above the floor or grade unless instructed otherwise by applicable code.
  2. Locate backflow preventers in same room as connected equipment or system.
  3. Install backflow preventers with an air gap drain cup provided by same manufacturer, located under the pressure differential section, and piped full size of the air gap to the nearest floor drain.
  4. Do not install bypass piping around backflow preventers.
- C. Install vacuum breakers on all outlets where hoses can be attached, such as laboratory faucets, service sinks, wall hydrant, etc.
- D. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install thermometers and water regulators if specified.
  2. Install cabinet-type units recessed in or surface mounted on wall as specified.

- E. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- F. Install water hammer arresters in water piping according to PDI-WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors/panels.
- G. Install air vents at high points of water piping.
- H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- I. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- J. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.
- K. Install trap primers in accessible locations. Do not install trap primers in ceilings.
- L. Install temperature and pressure relief valves in the shell of each domestic hot water generators, and as indicated on the drawings. Pipe the discharge connection from each valve to the drainage system through an open drain.
- M. Install integral spring check on all two-handle faucets where hoses can be attached.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

### 3.3 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

### 3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Pressure vacuum breakers.
  - 2. Reduced-pressure-principle backflow preventers.
  - 3. Carbonated-beverage-machine backflow preventers.
  - 4. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
  - 5. Water pressure-reducing valves.

6. Calibrated balancing valves.
7. Primary, thermostatic, water mixing valves.
8. Supply-type, trap-seal primer valves.
9. Trap-seal primer systems.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
  1. Test each pressure vacuum breaker and reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.6 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

## SECTION 221316 - SANITARY WASTE AND VENT PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
  - 1. Pipe, tube, and fittings.
- B. Related Sections include the following:
  - 1. Division 22 Section "Facility Sanitary Sewers."

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. LEED Submittal:
  - 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

## 1.7 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
  - 2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 PIPING MATERIALS

- A. Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting, and joining methods for specific services, service locations, and pipe sizes.

### 2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Heavy-Duty, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
    - a. ANACO-Husky; Series 4000.
    - b. Clamp-All Corp.
  - 2. Standards: ASTM C 1277 and ASTM C 1540.
  - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

### 2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
- C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of cast iron increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

- I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### 3.2 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

### 3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
  1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  2. Install individual, straight, horizontal piping runs:
    - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    - c. Longer than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10 mm) minimum rods.

- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
  - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
  - 4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
  - 5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
  - 3. NPS 4 and 5 (DN 100 and 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
  - 4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
  - 5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- H. Install supports for vertical PVC piping every 48 inches (1200 mm).
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Install horizontal backwater valves with cleanout cover flush with floor.
  - 5. Comply with requirements for backwater valves cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
  - 6. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.



### 3.5 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### 3.6 FIELD QUALITY CONTROL

- A. Drainage system shall be inspected and tested in accordance with State of Michigan Plumbing Code.
- B. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- C. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- E. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot (30 kPa) head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 6. Prepare reports for tests and required corrective action.

### 3.7 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

### 3.8 PIPING SCHEDULE

- A. Aboveground, soil and waste piping shall be any of the following:
  - 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- B. Aboveground, vent piping shall be any of the following:
  - 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316

## SECTION 221319 – SANITARY WASTE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
  - 1. Cleanouts.
  - 2. Miscellaneous sanitary drainage piping specialties.
- B. Related Sections include the following:
  - 1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

## PART 2 - PRODUCTS

### 2.1 CLEANOUTS

#### A. Cast-Iron Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. Sioux Chief Manufacturing Company, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Outlet Connection: Spigot.
7. Closure: Brass plug with straight threads and gasket.
8. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Heavy Duty.
11. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

#### B. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, stainless-steel cover plate with screw.

#### C. Shower/Toilet Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.

- c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
  3. Pattern: Floor drain.
  4. Body Material: Cast iron.
  5. Seepage Flange: Required.
  6. Clamping Device: Required.
  7. Outlet: Bottom.
  8. Top or Strainer Material: Nickel bronze.
  9. Top of Body and Strainer Finish: Nickel bronze.
  10. Top Shape: Round.
  11. Dimensions of Top or Strainer: 7"
  12. Top Loading Classification: Light Duty.
  13. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
  14. Trap Seal Protection: Barrier type.

## 2.2 AIR-ADMITTANCE VALVES

### A. Fixture Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. RectorSeal.
  - b. Studor, Inc.
2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

### B. Stack Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Oatey.
  - b. Studor, Inc.
2. Standard: ASSE 1050 for vent stacks.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected stack vent or vent stack.

### C. Wall Box:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. RectorSeal.
  - b. Studor, Inc.
2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
3. Size: About 9 inches wide by 8 inches high by 4 inches deep.

### 2.3 TRAP SEAL PROTECTION DEVICES

#### A. Barrier Type Trap Seal Protection Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. SureSeal Manufacturing; Inline Floor Drain Trap Sealer.
2. Standard: ASSE 1072-2007.
3. Body: ASB Plastic
4. Diaphragm & Sealing Gasket: Neoprene Rubber
5. Size: 2 inch (50 mm), 3 inch (75 mm), 3-1/2 inch (89 mm), or 4 inch (100 mm).
6. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

### 2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

#### A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
  - a. NPS 2: 4-inch minimum water seal.
  - b. NPS 2-1/2 and Larger: 5-inch minimum water seal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.
5. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor. In no cases shall access be from below, through the ceiling space.
6. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall. Cleanout plug shall not be recessed more than 1 inch from the cover plate at the finished wall.
7. Cleanouts for water closets shall be brought up to above flood rim of the fixtures.

- D. Plumbing fixtures are not to be used in place of cleanouts for the removal of obstruction.
- E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- F. Install fixture air-admittance valves on fixture drain piping.
- G. Install stack air-admittance valves at top of stack vent and vent stack piping.
- H. Install deep-seal traps on floor drains and other waste outlets.
- I. Install floor-drain, barrier type trap seal protection device on inlet to floor drains that require trap-seal protection.

1. Size: Same as floor drain inlet.

- J. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- K. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

1. .

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

### 3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319



## SECTION 224213.13 - COMMERCIAL WATER CLOSETS

### 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. Water closets.
2. Flushometer valves
3. Toilet seats.
4. Supports.

- B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential water closets.
2. Section 224300 "Medical Plumbing Fixtures" for healthcare water closets.
3. Section 224600 "Security Plumbing Fixtures" for security water closets.

#### 1.3 DEFINITIONS

- A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.
- B. Remote Water Closet: Located more than **30 feet** from other drain line connections or fixture and where less than 1.5 drainage fixture units are upstream of the drain line connection.

#### 1.4 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.

## PART 2 - PRODUCTS

### 2.1 WALL-MOUNTED WATER CLOSETS

- A. Water Closets WC-1: Wall mounted, top spud, antimicrobial flushometer bowl.
  - 1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Kohler Co; K-4325-SS Kingston™ Wall-mounted 1.6 or 1.28 gpf flushometer valve toilet bowl with top inlet, require or owner approved product by one of the following:
    - a. [American Standard.](#)
    - b. [Sloan Valve Company.](#)
    - c. [Zurn Industries, LLC.](#)
    - d. [Kohler Co.](#)
  - 2. Bowl:
    - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    - b. Material: Vitreous china.
    - c. Finish: Antimicrobial
    - d. Type: Siphon jet.
    - e. Style: Flushometer valve.
    - f. Height: Standard.
    - g. Rim Contour: Elongated.
    - h. Water Consumption: **1.6 gal.** per flush.
    - i. Spud Size and Location: **NPS 1-1/2**; top.
  - 3. Flushometer Valve: FV-1.
  - 4. Toilet Seat: TS-1.
  - 5. Support: Water closet carrier.
  - 6. Water-Closet Mounting Height: Standard.
- B. Water Closets : WC-2 Wall mounted, top spud, antimicrobial flushometer bowl, ADA accessible.
  - 1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Kohler Co; K-4325-SS Kingston™ Wall-mounted ADA compliant, 1.6 or 1.28 gpf flushometer valve toilet bowl with top inlet, require or owner approved product by one of the following:
    - a. [American Standard.](#)
    - b. [Sloan Valve Company.](#)
    - c. [Zurn Industries, LLC.](#)
    - d. [Kohler Co.](#)
  - 2. Bowl:

- a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
  - b. Material: Vitreous china.
  - c. Finish Antimicrobial
  - d. Type: Siphon jet.
  - e. Style: Flushometer valve.
  - f. Height: ADA compliant.
  - g. Rim Contour: Elongated.
  - h. Water Consumption: **1.6 gal.** per flush.
  - i. Spud Size and Location: **PS 1-1/2**; top.
3. Flushometer Valve: FV-1.
  4. Toilet Seat: TS-1.
  5. Support: Water closet carrier.
  6. Water-Closet Mounting Height: Handicapped/elderly according to ICC/ANSI A117.1.

## 2.2 FLUSHOMETER VALVES

### A. Battery Operated, ADA Compliant, Solenoid-Actuator, Piston Flushometer Valves (FV-1):

1. Basis-of-Design Product: Subject to compliance with requirements, provide TOTO; "Ecopower" Model # TET6GA or owner approved product by one of the following:
  - a. American Standard
  - b. Zurn Industries, LLC.
  - c. Sloan Valve Company.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: **125 psig.**
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
10. Trip Mechanism: Battery Operated electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
11. Consumption: **1.6 gal.** per flush.
12. Minimum Inlet: **NPS 1.**
13. Minimum Outlet: **NPS 1-1/4.**

## 2.3 TOILET SEATS

### A. Toilet Seats (TS-1):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Kohler Co; Model # K-4731-GA "Stronghold" Elongated toilet seat with support arms or owner approved product by one of the following:
  - a. American Standard.

- b. [Centoco Manufacturing Corporation.](#)
  - c. [Church Seats; Bemis Manufacturing Company.](#)
  - d. [Olsonite Seat Co.](#)
  - e. [Zurn Industries, LLC.](#)
2. Standard: IAPMO/ANSI Z124.5.
  3. Material: Plastic.
  4. Type: Commercial (Heavy duty).
  5. Shape: Elongated rim, open front.
  6. Hinge: Self-sustaining, check.
  7. Hinge Material: Noncorroding metal.
  8. Seat Cover: Not required.
  9. Color: White.

## 2.4 SUPPORTS

### A. Water Closet Carrier:

1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
  - a. [J.R. Smith.](#)
  - b. [Zurn Industries, LLC.](#)
2. Standard: ASME A112.6.1M.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

#### A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

#### B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.
5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.3 CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

### 3.4 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

## SECTION 224216.13 - COMMERCIAL LAVATORIES

### 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. Lavatories.
2. Faucets.
3. Supply fittings.
4. Waste fittings.
5. Supports.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
  2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranty.
- B. Manufacturer's certificates.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Servicing and adjustments of automatic faucets.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
  2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

## PART 2 - PRODUCTS

### 2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

- A. Lavatory LAV-1: Rectangular, vitreous china, undercounter mounted.
1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Kohler Co; "Ladena" Model K-2215 or owner approved product by one of the following:
    - a. **American Standard.**
    - b. Symmons
  2. Fixture:
    - a. Standard: ASME A112.19.2/CSA B45.1.
    - b. Type: For undercounter mounting.
    - c. Nominal Size: Rectangular, 23.25 by 16.25 inches (591 by 413 mm) .
    - d. Faucet-Hole Punching: No holes.
    - e. Faucet-Hole Location: On countertop.
    - f. Color: White.
    - g. Mounting Material: Sealant and undercounter mounting kit.
    - h. With integral overflow
  3. Faucet: LF-1.
  4. 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.
  5. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
  6. Body Type: Single hole.
  7. Body Material: Commercial, solid brass.
  8. Finish: Brushed Nickel.
  9. Maximum Flow Rate: **0.5 gpm.**
  10. Mounting Type: Deck, concealed.
  11. Spout: Rigid type.
  12. Spout Outlet: Aerator.
  13. Drain: Grid Strainer
  14. Provide with lead-free ASSE 1070 compliant mixing valve equal to Leonard Valve Model #170A-LF.



## 2.2 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
  - 1. NPS 1/2.
  - 2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

## 2.3 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
  - 1. Size: NPS 1-1/2 by NPS 1-1/4.
  - 2. Material: Chrome-plated, two-piece, 18 gauge with cleanout plug, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated, brass or steel wall flange.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install lavatories level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.

- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### 3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

### 3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

### 3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

### 3.6 TESTING AND ADJUSTING

- A. Set field-adjustable temperature set points of temperature-actuated water mixing valves. Adjust set point within allowable temperature range.
- B. Test and adjust installation.

END OF SECTION 224216.13

## SECTION 224216.16 - COMMERCIAL SINKS

### 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. Kitchen/utility sinks.
2. Manually operated sink faucets.
3. Supply fittings.
4. Waste fittings.
5. Sink supports.

- B. Related Requirements:

1. Section 114000 "Foodservice Equipment" for NSF-compliant foodservice and handwash sinks.
2. Section 224100 "Residential Plumbing Fixtures" for residential sinks.

#### 1.3 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics and furnished specialties and accessories.

#### 1.4 INFORMATIONAL SUBMITTALS

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sinks and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - a. Servicing and adjustments for automatic faucets.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
  2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

## PART 2 - PRODUCTS

### 2.1 KITCHEN/UTILITY SINKS

- A. Kitchen/Utility Sinks - Stainless Steel, Counter Mounted: Sink-1 .
1. **Basis-of-Design Product:** Subject to compliance with requirements, provide [Elkay](#); "Crosstown" ADA compliant undermount single bowl dual mount sink model # ECTSRAD25226TBG or owner approved product by one of the following:
    - a. Advance Tabco.
    - b. Just Manufacturing.
  2. Source Limitations: Obtain sinks from single source from single manufacturer.
  3. Fixture:
    - a. Standard: ASME A112.19.3/CSA B45.4.
    - b. Type: Stainless steel, undermount, sound-deadened unit .
    - c. Number of Compartments: One .
    - d. Overall Dimensions: 25"x22"x6" .
    - e. Material: 18 gauge, Type 304 stainless steel.
    - f. Compartment:
      - 1) Dimensions: 22.5" x 16.75"x 6" .
      - 2) Drain: Grid with **NPS 1-1/2** tailpiece and twist drain .
      - 3) Drain Location: Near back of compartment .
      - 4) Depth: Standard .
  4. Faucet(s): Kitchen Sink Faucet .
    - a. Number Required: One per sink.
    - b. Mounting: On ledge.
  5. Supply Fittings:
    - a. Standard: ASME A112.18.1/CSA B125.1.
    - b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
      - 1) Operation: Loose key .
      - 2) Risers: **NPS 1/2**, chrome-plated, soft-copper flexible tube .
  6. Waste Fittings:
    - a. Standard: ASME A112.18.2/CSA B125.2.
    - b. Trap(s):
      - 1) Size: **NPS 1-1/2** .
      - 2) Material:
        - a) Chrome-plated, two-piece, cast-brass trap with cleanout plugs and swivel elbow with 18-gauge brass tube to wall ; and chrome-plated brass or steel wall flange.
  7. Mounting: under counter with sealant.

## 2.2 MANUALLY OPERATED VANADL-PROOF SINK FAUCETS

- A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Commercial Sink Faucets - Manual Type: Two-handle mixing , Kitchen Sink Faucet .
1. **Basis-of-Design Product:** Subject to compliance with requirements, provide [Chicago Faucets; Geberit Company](#); Model # 201-GN8AE3-317XKAB or owner approved product by one of the following:
    - a. American Standard.
    - b. Elkay.
    - c. Kohler Co.
  2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
  3. Standard: ASME A112.18.1/CSA B125.1.
  4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
  5. Body Type: Centerset .
  6. Body Material: Commercial, solid brass, or die-cast housing with brazed copper and brass waterway.
  7. Finish: Chrome plated .
  8. Maximum Flow Rate: 2.2 gpm. .
  9. Mounting Type: Deck, exposed .
  10. Valve Handle(s): Lever .
  11. Spout Type: Rigid Swivel gooseneck .
  12. Vacuum Breaker: Not required for hose outlet.
  13. Spout Outlet: Aerator .
  14. Side spray unit and hose supplied with faucet fin Lactation room only.
- C. Commercial Service Sink Faucets - Manual Type: SSF-1 .
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Acorn Engineering Company; a Division of Morris Group International.
    - b. American Standard.
    - c. Fiat Products.
    - d. Speakman Company.
    - e. T&S Brass and Bronze Works, Inc.
    - f. Zurn Industries, LLC.
  2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
  3. Description: Wall/back mounted, brass body, with integral service stops, checks, spout with bucket/pail hook, **3/4-inch** hose thread end, integral vacuum breaker, inlets **8 inches** o.c., and two-handle mixing.
  4. Faucet:
    - a. Standards:
      - 1) ASME A112.18.1/CSA B125.1.
      - 2) NSF 61 and NSF 372.
      - 3) ICC A117.1.
      - 4) ASSE 1001 (VB).
    - b. Finish: Rough chrome plated .
    - c. Handles: Lever .
    - d. Cartridges: Ceramic .

- e. Brace: Adjustable top brace .

## 2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key .
- F. Risers:
  - 1. NPS 3/8 .
  - 2. Chrome-plated, rigid-copper pipe .

## 2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
  - 1. Size: NPS 1-1/2.
  - 2. Material:
    - a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 18-gauge brass tube to wall with cleanout plug ; and chrome-plated brass or steel wall flange.

## 2.5 GROUT

- A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install sinks level and plumb in accordance with rough-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install wall-mounted sinks at accessible mounting height in accordance with ICC A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
  - 1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
  - 2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

#### 3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."



### 3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
  - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least **1/2 inch** high.

### 3.5 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

### 3.6 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
  - B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
  - C. Provide protective covering for installed sinks and fittings.
  - D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.
- END OF SECTION 224216.16

## SECTION 224716 - PRESSURE WATER COOLERS

### 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. Pressure water coolers.
  - 2. Supports.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of pressure water cooler and bottle filling station.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Include diagrams for power wiring.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For pressure water coolers and bottle filling stations to include in maintenance manuals.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than 1 of each.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

#### A. Standards:

1. Pressure water coolers and bottle filling stations intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
2. Comply with ASHRAE 34 for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
3. Comply with UL 399.
4. Comply with ASME A112.19.3/CSA B45.4.
5. 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.
6. Comply with NSF 42 and NSF 53 for water filters for water coolers and bottle filling stations.
7. Comply with ICC A117.1 for accessible water coolers and bottle filling stations.

### 2.2 PRESSURE WATER COOLERS

#### A. Pressure Water Coolers - Surface Wall-Mounted, Stainless Steel: EWC-1and EWC-2.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide [Elkay](#); Model #EZS8WSLK or owner approved product by one of the following:
  - a. Halsey Taylor.
  - b. Oasis International.
2. Source Limitations: Obtain surface wall-mounted, stainless steel, pressure water coolers from single source from single manufacturer.
3. Bubbler: One, with adjustable stream regulator, located on cabinet deck.
4. Control: Front and side Push bar Activation.
5. Bottle Filler: Sensor activation automatic shutoff timer: Fill rate **0.5 to 1.5 gpm** .
6. Drain: Grid with **NPS 1-1/4** tailpiece.
7. Supply: **NPS 3/8** with shutoff valve.
8. Waste Fitting: ASME A112.18.2/CSA B125.2, **NPS 1-1/4** brass P-trap.
9. Filter: One or more water filters with capacity sized for unit peak flow rate.
10. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
11. Support: Water-cooler carrier.
12. Water-Cooler Mounting Height: Standard Accessible in accordance with ICC A117.1
13. Capacities and Characteristics:
  - a. Cooled Water: **8 gph**
  - b. Ambient-Air Temperature: **90 deg F**.
  - c. Inlet-Water Temperature: **80 deg F**.
  - d. Cooled-Water Temperature: **50 deg F**.
  - e. Electrical Characteristics:
    - 1) Volts: 120 V ac.
    - 2) Phase: Single.
    - 3) Hertz: 60 Hz.
    - 4) Full-Load Amperes: 6 A.

## 2.3 SUPPORTS

### A. Water-Cooler Carrier:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Wade Drains.
  - e. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Set freestanding, pressure water coolers on floor.
- C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- D. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers, and bottle filling stations to mounting frames.
- E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping"
- F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping"
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

### 3.4 ELECTRICAL CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplates to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

### 3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

### 3.6 CLEANING

- A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224716

## SECTION 230500 - COMMON WORK RESULTS FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Dielectric fittings.
  - 3. HVAC demolition.
  - 4. Supports and anchorages.

#### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Dielectric fittings.

- B. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### 1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate systems shutdown (water, fire protection, hot water heating, steam, chilled water, etc.) with the Project Manager/Project Representative. Activation and shut down of existing systems shall be conducted by personnel only.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

## 2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, 95/5 lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Perfection Corp.; Clearflow Dielectric Waterway.
    - b. Victaulic Co. of America.



## 2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- D. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 2.6 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
  - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### 3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Piping shall not project beyond walls or steel lines nor shall it hang below slabs more than is absolutely necessary. Particular attention shall be paid to the required clearances.
- F. Offset piping where required to avoid interference with other work, to provide greater headroom or clearance, or to conceal pipe more readily. Offsets shall be properly drained or trapped where necessary.
- G. Provide swing joints and expansion bends wherever required to allow the piping to expand without undue stress to connections or equipment.
- H. Exposed piping around fixtures or in other conspicuous places shall not show tool marks at fittings.
- I. Isolate pipe from the building construction to prevent transmission of vibration to the structure and to eliminate noise.
- J. Install piping such that any equipment connected to piping may be removed by disconnecting two (2) flanges or unions and removing only one or two pipe sections. All equipment shall have bolted or screwed flanges or unions at pipe connections.
- K. Install fittings for changes in direction and branch connections. T-drill system for mechanically formed tee connections and couplings, and Victaulic hole cut piping system are not allowed.
- L. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.
- M. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- N. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

- O. Install piping to permit valve servicing.
- P. Install piping at indicated slopes.
- Q. Install piping free of sags and bends.
- R. Install piping to allow application of insulation.
- S. Eccentric reducing couplings shall be provided in all cases where air or water pockets would otherwise occur due to a reduction in pipe size.
- T. Cap and plug all openings in pipes during construction with suitable metal plugs or cap to keep out dirt and rubbish until equipment is connected.
- U. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- V. Select system components with pressure rating equal to or greater than system operating pressure.
- W. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - b. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
    - c. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
    - d. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
    - e. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
  - 2. Existing Piping: Use the following:
    - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
    - b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
    - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
    - f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
    - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

- X. All pipes extending through the roof shall be flashed with six pound lead flashing extending 6 inches beyond the pipe, welded to a lead sleeve extended up around the vent pipes, and rolled over into the pipe.
- Y. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
  - 1. Sleeves placed in floors shall be flush with the ceiling and shall have planed, square ends, extending 2 inches above the finished floor, unless otherwise specified or detailed.
  - 2. Where sleeves pass through reinforced concrete floors, they shall be properly set in position before the concrete is poured, and shall be maintained in position by the Contractor until the concrete is set.
  - 3. Sleeves placed in concrete beams shall be flush with the side of the beam and large enough to accommodate the bare pipe only. All other sleeves shall be of adequate size to accommodate pipe insulation undiminished in size.
  - 4. Pipes passing through below grade perimeter walls or slabs on grade shall have the space between the pipe and sleeve sealed watertight.
  - 5. Pipes passing through above grade floor slabs and masonry walls shall have the space between the pipe or insulation and the sleeve packed with non-asbestos wicking or other suitable, approved, non-combustible material.
  - 6. Pipes passing through walls of Mechanical Equipment Rooms shall be made gas-tight by caulking the space between the pipe and sleeve with a fiber saturated with an approved type of plastic material.
  - 7. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Z. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- AA. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- BB. Verify final equipment locations for roughing-in.
- CC. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
- B. Unions shall be used in preference to couplings where their use will facilitate dismantling the pipe for maintenance.
- C. Pipe sizes indicated shall be carried full size to equipment served. Any change of size to match equipment connection shall be made within one foot of the equipment. At temperature control valves with sizes smaller than connected lines, reduction shall be made immediately adjacent to valves.
- D. No Uni-flange pipe adapters will be allowed.

### 3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6

### 3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- E. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- F. Field Welding: Comply with AWS D1.1.

3.8

END OF SECTION 230500

## SECTION 230713 - DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Outdoor, exposed supply and return.
- B. Related Sections:
  - 1. Section 230716 "HVAC Equipment Insulation."
  - 2. Section 230719 "HVAC Piping Insulation."
  - 3. Section 233113 "Metal Ducts" for duct liners.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having

jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

#### 1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

### PART 2 - PRODUCTS

#### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.



- E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corporation; SoftTouch Duct Wrap.
    - b. Johns Manville; a Berkshire Hathaway company; Microlite.
    - c. Knauf Insulation; Atmosphere Duct Wrap with ECOSE Technology.
    - d. Manson Insulation Inc; Alley Wrap.
    - e. Owens Corning; SOFTR All-Service Duct Wrap.
- F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.."
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corporation; Commercial Board.
    - b. Johns Manville; a Berkshire Hathaway company; 800 Series Spin-Glas.
    - c. Knauf Insulation; Earthwool Insulation Board with ECOSE Technology.
    - d. Manson Insulation Inc; AK Board.
    - e. Owens Corning; Fiberglas 700 Series.

## 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products; CP-127.
    - b. Eagle Bridges - Marathon Industries; CP-127. Eagle Bridges - Marathon Industries; 225..
    - c. Foster Brand; H. B. Fuller Construction Products; 85-60/85-70.
    - d. Mon-Eco Industries, Inc; 22-25.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products; CP-82.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products; 85-50.
    - d. Mon-Eco Industries, Inc; 22-25.

## 2.3 MASTICS

- A. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products; CP-38 Chil-Low.
    - b. Foster Brand; H. B. Fuller Construction Products; 30-80.
    - c. Knauf Insulation; EXPERT Mastics - KI-900 ASJ.
    - d. Vimasco Corporation.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products; CP-30.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products; 30-35.
    - d. Mon-Eco Industries, Inc; 55-10.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
  3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
  4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products; Encacel.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products; 60-95/60-96.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
  3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
  4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  5. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products; CP-10.
    - b. Eagle Bridges - Marathon Industries.

- c. Foster Brand; H. B. Fuller Construction Products; 46-50.
  - d. Knauf Insulation; EXPERT Mastics - KI-700 ASJ.
  - e. Mon-Eco Industries, Inc; 55-50.
  - f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
  4. Solids Content: 60 percent by volume and 66 percent by weight.
  5. Color: White.

## 2.4 SEALANTS

### A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand; H. B. Fuller Construction Products; CP-76.
  - b. Eagle Bridges - Marathon Industries; CP-76.Eagle Bridges - Marathon Industries; 405..
  - c. Foster Brand; H. B. Fuller Construction Products; 95-44.
  - d. Mon-Eco Industries, Inc; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.

### B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand; H. B. Fuller Construction Products; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.

## 2.5 FACTORY-APPLIED JACKETS

### A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## 2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Metal Jacket:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ITW Insulation Systems; Illinois Tool Works, Inc; Aluminum and Stainless Steel Jacketing.
    - b. RPR Products, Inc; Insul-Mate.
  2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 1-mil-(0.025-mm-)thick, heat-bonded polyethylene and kraft paper
    - d. Moisture Barrier for Outdoor Applications: 3-mil-(0.075-mm-)thick, heat-bonded polyethylene and kraft paper.

## 2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - b. Compac Corporation; 104 and 105.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; Ideal Tape Cold Seal 728 ASJ.
    - d. Knauf Insulation; EXPERT Tapes - ASJ Tape.
    - e. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches (75 mm).
  3. Thickness: 11.5 mils (0.29 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - b. Compac Corporation; 110 and 111.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK][Ideal Tape Cold Seal 791 FSK.
    - d. Knauf Insulation; EXPERT Tapes - FSK Tape.
    - e. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches (75 mm).
  3. Thickness: 6.5 mils (0.16 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Compac Corporation.
    - b. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - c. Venture Tape; 1506 CW NS.
  2. Width: 2 inches (50 mm).
  3. Thickness: 6 mils (0.15 mm).
  4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corporation.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Knauf Insulation; EXPERT Tapes - 2 Mil Foil Tape.
    - e. Venture Tape; 3520 CW.
  2. Width: 2 inches (50 mm).
  3. Thickness: 3.7 mils (0.093 mm).
  4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

## 2.8 SECUREMENTS

### A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ITW Insulation Systems; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

### B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; CD.
    - 3) Midwest Fasteners, Inc.; CD.
    - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CHP-1.
    - 2) GEMCO; Cupped Head Weld Pin.
    - 3) Midwest Fasteners, Inc.; Cupped Head.
    - 4) Nelson Stud Welding; CHP.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.

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

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-(75-mm-)wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.



- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

- E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
  - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Impale insulation over pins and attach speed washers.
  - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-

applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-(150-mm)-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

- b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-(150-mm-)wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch-(1.6-mm-)thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch-(75-mm-)wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

### 3.8 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.10 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Outdoor, exposed supply and return.
- B. Items Not Insulated:
  - 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  - 2. Factory-insulated flexible ducts.
  - 3. Factory-insulated plenums and casings.
  - 4. Flexible connectors.
  - 5. Vibration-control devices.
  - 6. Factory-insulated access panels and doors.

### 3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
  - 2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

- B. Concealed, round and flat-oval, return-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
  2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
- C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
  2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
- D. Concealed, rectangular, supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
  2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
- E. Concealed, rectangular, return-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
  2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density..
- F. Concealed, rectangular, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
  2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
- G. Exposed, round and flat-oval, supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
  2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
- H. Exposed, round and flat-oval, return-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
  2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
- I. Exposed, round and flat-oval, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.

2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

J. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

K. Exposed, rectangular, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

L. Exposed, rectangular, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

### 3.12 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Exposed, round and flat-oval, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

C. Exposed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

### 3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. Aluminum, Smooth: 0.020 inch (0.51 mm) thick.

D. Ducts and Plenums, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):

1. Aluminum, Smooth 0.020 inch (0.51 mm) thick.

END OF SECTION 230713

## SECTION 233113 – METAL DUCTS

### 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. Single-wall rectangular ducts and fittings.
- 2. Single-wall round and flat-oval ducts and fittings.
- 3. Sheet metal materials.
- 4. Sealants and gaskets.
- 5. Hangers and supports.

- B. Related Sections:

- 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
- 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article unless otherwise indicated.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of the following products:
  - 1. Sealants and gaskets.
- B. Shop Drawings:



1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  2. Factory- and shop-fabricated ducts and fittings.
  3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
  4. Elevation of top of ducts.
  5. Dimensions of main duct runs from building grid lines.
  6. Fittings.
  7. Reinforcement and spacing.
  8. Seam and joint construction.
  9. Penetrations through fire-rated and other partitions.
  10. Equipment installation based on equipment being used on Project.
  11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
  12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Coordination Drawings: 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. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  2. Suspended ceiling components.
  3. Structural members to which duct will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Penetrations of smoke barriers and fire-rated construction.
  6. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Perimeter moldings.
- D. Field quality-control reports.
- 1.5 QUALITY ASSURANCE
- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
  - B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

## PART 2 - PRODUCTS

### 2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Standing seams T-15, angle reinforced standing seams T-16, welded flange T-21, reinforced welded flange T-21a, companion angles T-22, and formed-on flanges T-25a (TDC) and T-25b (TDF)
  - 2. Use of drives slip seams on sides is acceptable for unreinforced ducts.
  - 3. Use of tie rodded reinforcement alternative is not acceptable.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. All longitudinal seams on flat sides shall be of the grooved seam L-3.
  - 2. All longitudinal corner seams shall be of the Pittsburgh lock L-1.
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Smooth radius with at least one splitter vane and square throat R/W equal to 0.5 or higher.
  - 2. Mitered and Tee-shape elbows with turning vanes are acceptable where space restrictions dictate.
  - 3. Select 45 degree entry tees, conical or bell mouth tees, or wyees. Straight tap connections will not be accepted.
- E. As an option, Ductmate proprietary duct connection systems may be used with permission of the Architect/Engineer. Refer to the manufacturer guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

### 2.2 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90 (Z275).
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
  
- C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90 (Z275).
  - 2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils (0.10 mm) thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil (0.025 mm) thick on opposite surface.
  - 3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.
  
- D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
  
- E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
  
- F. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
  
- G. Factory- or Shop-Applied Antimicrobial Coating:
  - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
  - 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
  - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
  - 5. Shop-Applied Coating Color: Black.
  - 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
  
- H. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
  
- I. Tie Rods: Galvanized steel, 1/4-inch (6 mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10 mm) minimum diameter for lengths longer than 36 inches (900 mm).

## 2.3 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches (76 mm).
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 degree C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

## 2.4 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Hot-dipped galvanized steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Use fabricated fittings for all changes in directions, sizes, shapes and connections.
- N. Locate ducts parallel and perpendicular to building lines; avoid diagonal runs except as otherwise indicated.

### 3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Return-Air Ducts: Seal Class B.
6. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
7. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
8. Conditioned Space, Exhaust Ducts: Seal Class B.
9. Conditioned Space, Return-Air Ducts: Seal Class C.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  1. Where practical, install concrete inserts before placing concrete.
  2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing.
  1. Install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
  2. Install hangers at duct joints on either 8 or 10 foot centers, and at every change of direction.
  3. Support ductwork directly from the building structure; not from the other ducts, piping, equipment, or roof deck.
  4. Holes shall not be drilled or punched in beams and supporting members.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  - 2. Test the following systems:
    - a. Ducts with a Pressure Class Higher Than 3-Inch wg (750 Pa): Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
  - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 4. Test for leaks before applying external insulation.
  - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
  - 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
  - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.7 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.



1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Return-air ducts, dampers, and turning vanes except in ceiling plenums and mechanical equipment rooms.
4. Supply-air ducts, dampers, and turning vanes.
5. Dedicated exhaust and ventilation components and makeup air systems.

D. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.8 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior.

- B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive 2-inch wg (500 Pa).
    - b. Minimum SMACNA Seal Class: C.
  2. Ducts Connected to Constant-Volume Air-Handling Units:
    - a. Pressure Class: Positive 3-inch wg (750 Pa).
    - b. Minimum SMACNA Seal Class: B.
  3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
    - a. Pressure Class: Positive 4-inch wg (1000 Pa).
    - b. Minimum SMACNA Seal Class: A.
- C. Return Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
    - b. Minimum SMACNA Seal Class: C.
  2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 3-inch wg (750 Pa).
    - b. Minimum SMACNA Seal Class: B.
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 3-inch wg (750 Pa).
    - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class: 3.
    - d. .
- E. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.
  2. PVC-Coated Ducts:
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: Match duct material.
  3. Stainless-Steel Ducts:
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: Galvanized.
- F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Velocity 1000 fpm (5 m/s) or Lower:
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
    - 2) Mitered Type RE 4 without vanes.
  - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - c. Velocity 1500 fpm (7.6 m/s) or Higher:
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm (5 m/s) or Lower: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm(5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - 4) Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam or welded.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connections."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Spin in.
  
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
  - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
  - c. Velocity 1500 fpm (7.6 mm) or Higher: 45-degree lateral.

END OF SECTION 233113

## SECTION 233300 - AIR DUCT 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. Manual volume dampers
  - 2. Flange connectors
  - 3. Turning vanes
  - 4. Flexible connectors
  - 5. Flexible ducts
  - 6. Duct accessory hardware
- B. Related Sections:
  - 1. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
  - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings
    - b. Manual volume damper installations
    - c. Control damper installations
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- D. Source quality-control reports.

- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90 (Z275)
  - 2. Exposed-Surface Finish: Mill phosphatized
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304.
- D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

#### 2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Air Balance Inc.; a division of Mestek, Inc.
    - b. Greenheck Fan Corporation
    - c. Louvers and Dampers; a division of Mestek, Inc.
    - d. McGill AirFlow LLC
    - e. Nailor Industries Inc.

- f. Ruskin Company
  2. Standard leakage rating, with linkage outside airstream.
  3. Suitable for horizontal or vertical applications.
  4. Frames:
    - a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62 mm) minimum thickness.
    - b. Mitered and welded corners.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized-steel, 0.064 (1.62 mm) inch thick.
  6. Blade Axles: Galvanized steel.
  7. Bearings:
    - a. Oil-impregnated bronze or molded synthetic.
    - b. Dampers in ducts with pressure classes of 3-inch (750 Pa) wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  8. Tie Bars and Brackets: Galvanized steel.
- B. Jackshaft:
  1. Size: 1-inch (25 mm) diameter.
  2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
  1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch (2.4 mm) thick zinc-plated steel, and a 3/4-inch (19 mm) hexagon locking nut.
  2. Include center hole to suit damper operating-rod size.
  3. Include elevated platform for insulated duct mounting.

## 2.3 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ductmate Industries, Inc.
  2. Nexus PDQ; Division of Shilco Holdings Inc.
  3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

#### 2.4 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
  - 2. METALAIRE, Inc.
  - 3. SEMCO Incorporated
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vaness and Vane Runners," and 2-4, "Vane Support in Elbows."
- D. Vane Construction: Double wall.

#### 2.5 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
  - 2. Ventfabrics, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.
- A. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
  - 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
- A. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.



1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
  2. Minimum Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
  3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).
- A. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
1. Minimum Weight: 14 oz./sq. yd. (474 g/sq. m).
  2. Tensile Strength: 450 lbf/inch (79 N/mm) in the warp and 340 lbf/inch (60 N/mm) in the filling.
  3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).
- A. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

## 2.6 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexmaster U.S.A., Inc.; Type 8M
  2. McGill AirFlow LLC
- B. Acoustical, Insulated, Flexible Duct: UL 181, Class 1, CPE inner film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
  2. Maximum Air Velocity: 4000 fpm (20 m/s).
  3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
  4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.
- C. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

## 2.15 DUCT ACCESSORY HARDWARE

- D. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- E. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
  - 3. Do not use extractors, splitter-type dampers, and register or diffuser dampers for volume control.
  - 4. Locate volume dampers at least two diameters from a fitting and as far as possible from outlets.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream and downstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 7. At each change in direction and at maximum 50-foot (15-m) spacing.
  - 8. Upstream from turning vanes.
  - 9. Upstream or downstream from duct silencers.
  - 10. Control devices requiring inspection.
  - 11. Upstream from flow measuring stations.

12. Upstream from steam humidifiers.
13. In duct below roof ventilators or fans to service dampers.
14. Elsewhere as indicated.

G. Install access doors with swing against duct static pressure.

H. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

I. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

J. Install flexible connectors to connect ducts to equipment.

K. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

L. Connect diffusers or light troffer boots to ducts with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

M. Connect flexible ducts to metal ducts with draw bands.

N. Install duct test holes where required for testing and balancing purposes.

O. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

### 3.2 FIELD QUALITY CONTROL

P. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

## SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

### 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. Ceiling diffusers.
  - 2. Registers and grilles.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Source quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Price Industries.
  - 2. Titus.

#### 2.2 GENERAL REQUIREMENTS

- A. Air inlets and outlets shall be tested in accordance with ASHRAE 70.

- B. Throw, horizontal distance from the diffuser to the point where the theoretical centerline velocity is 50 feet per minute, shall not exceed the horizontal distance between the diffuser and the nearest wall, or half the horizontal distance between ceiling diffusers.

## 2.3 CEILING DIFFUSERS

1.

- B. Rectangular and Square Ceiling Diffusers:

- 1. Devices shall be specifically designed for variable-air-volume flows.
- 2. Material: Steel.
- 3. Finish: Baked enamel, white.
- 4. Face Style: Three cone.
- 5. Pattern: Adjustable Throw
- 6. Dampers

## 2.4 REGISTERS AND GRILLES

- A. Supply Air Bar Grille:

- 1. Material: Steel.
- 2. Finish: Baked enamel, white.
- 3. Face Blade Arrangement: Adjustable. Vertical spaced 3/4 inch (19 mm) apart.
- 4. Rear Blade Arrangement: Adjustable. Horizontal spaced 3/4 inch (19 mm) apart.
- 5. Frame: 1-1/4 inches (32 mm) wide.
- 6. Mounting: Countersunk screw, concealed, or lay in as scheduled.

- B. Return Air Bar Grille:

- 1. Material: Steel.
- 2. Finish: Baked enamel, white.
- 3. Face Blade Arrangement: 45 degree fixed horizontal spaced 3/4 inch (19 mm) apart.
- 4. Frame: 1-1/4 inches (32 mm) wide.
- 5. Mounting: Countersunk screw, concealed, or lay in as scheduled.

## 2.5 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Adjust the classroom grilles to prevent strong drafts.

### 3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

## SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

- A. This section includes the following:
1. Electrical equipment coordination and installation.
  2. Sleeves for raceways and cables.
  3. Sleeve seals.
  4. Common electrical installation requirements.

### PART 2 - PRODUCTS

#### 2.01 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

#### 2.02 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  3. Pressure Plates: Stainless steel. Include two for each sealing element.
  4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

#### 2.03 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 - EXECUTION

### 3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.02 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- J. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.



3.03 SLEEVE-SEAL INSTALLATION

- A. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.04 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 260513 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35,000 V.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.  
B. Product Schedule: Indicate type, use, location, and termination locations.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [Alpha Wire Company](#).
  2. [Cerro Wire LLC](#).
  3. [General Cable Technologies Corporation](#).
  4. [Okonite Company \(The\)](#).
  5. [Southwire Company](#).
  6. Encore Wire
- C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  2. RoHS compliant.
  3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
1. Type THHN and Type THWN-2: Comply with UL 83.
  2. Type XHHW-2: Comply with UL 44.

## 2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [3M Electrical Products.](#)
  2. [Hubbell Power Systems, Inc.](#)
  3. [Ideal Industries, Inc.](#)
  4. [ILSCO.](#)
  5. [O-Z/Gedney; a brand of Emerson Industrial Automation.](#)
  6. [TE Connectivity Ltd.](#)
  7. [Thomas & Betts Corporation; A Member of the ABB Group.](#)

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; stranded.
- B. Branch Circuits: Copper, stranded.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- H. Branch Circuits in Damp or Wet Locations, Type XHHW-2, single conductors in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

END OF SECTION 260519

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Foundation steel electrodes.

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
  - 1. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
    - a. Ground rods.
    - b. Ground rings.
    - c. Grounding arrangements and connections for separately derived systems.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- 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. Comply with UL 467 for grounding and bonding materials and equipment.

### 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. [Burdny; Part of Hubbell Electrical Systems.](#)
  - 2. [ERICO International Corporation.](#)
  - 3. [Galvan Industries, Inc.; Electrical Products Division, LLC.](#)
  - 4. [ILSCO.](#)
  - 5. [O-Z/Gedney; a brand of Emerson Industrial Automation.](#)
  - 6. [Thomas & Betts Corporation; A Member of the ABB Group.](#)

### 2.3 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Stranded Conductors: ASTM B 8.
  - 2. Tinned Conductors: ASTM B 33.
  - 3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 4. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 5. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

### 2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

- C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.
- K. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- L. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.

- a. Material: Copper or Cast Bronze.
- b. Listed for direct burial.

## 2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.
- B. Ground Plates: 1/4 inch (6 mm) thick, hot-dip galvanized.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No.8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No.4/0 AWG minimum.
- C. Bury at least 24 inches below grade.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.



E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 4/0 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Feeders and branch circuits.
  2. Lighting circuits.
  3. Receptacle circuits.
  4. Single-phase motor and appliance branch circuits.
  5. Three-phase motor and appliance branch circuits.

### 3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency (NECA member contractor, with NETA accreditation, and technician completing the tests with a minimum level 3 NETA certification) and to perform tests and inspections.
- B. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 5 ohms.
  2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 3 ohms.
  3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
  4. Substations and Pad-Mounted Equipment: 3 ohms.
  5. Manhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Hangers and supports for electrical equipment and systems.
  2. Construction requirements for concrete bases.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
1. Include design calculations and details of trapeze hangers.
  2. Die cast and spring steel components are not acceptable.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved:
- B. Welding certificates.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

#### 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit; a part of Atkore International.
    - b. B-line, an Eaton business.
    - c. ERICO International Corporation.
    - d. Thomas & Betts Corporation; A Member of the ABB Group.
    - e. Unistrut; Part of Atkore International.

2. Material: Stainless Steel, Grade 316.
  3. Channel Width: 1-5/8 inches.
  4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
  8. Channel Dimensions: Selected for applicable load criteria.
- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) B-line, an Eaton business.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti, Inc.
      - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.
  2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
  3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  5. Hanger Rods: Threaded steel.

## 2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.
- B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Structural members in paths of conduit groups with common supports.
  2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Tube & Conduit; a part of Atkore International.
  2. O-Z/Gedney; a brand of Emerson Industrial Automation.
  3. Republic Conduit.
  4. Southwire Company.
  5. Thomas & Betts Corporation; A Member of the ABB Group.
  6. Western Tube and Conduit Corporation.
  7. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.



- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Compression.
  - 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- G. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. [Anamet Electrical, Inc.](#)
  - 2. [CANTEX INC.](#)
  - 3. [CertainTeed Corporation.](#)
  - 4. [Condux International, Inc.](#)
  - 5. [RACO; Hubbell.](#)
  - 6. [Thomas & Betts Corporation; A Member of the ABB Group.](#)
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. ENT: Comply with NEMA TC 13 and UL 1653.
- D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- F. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. [Hubbell Incorporated; Wiring Device-Kellems.](#)
    - b. [MonoSystems, Inc.](#)
    - c. [Panduit Corp.](#)
    - d. [Wiremold / Legrand.](#)

- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Hubbell Incorporated.
  - b. MonoSystems, Inc.
  - c. Panduit Corp.
  - d. Wiremold / Legrand.

## 2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business.
  2. Hoffman; a brand of Pentair Equipment Protection.
  3. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R or Type 12 unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall not be permitted.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

## 2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Adalet.
  2. Crouse-Hinds, an Eaton business.
  3. EGS/Appleton Electric.
  4. Erickson Electrical Equipment Company.
  5. Hoffman; a brand of Pentair Equipment Protection.
  6. Hubbell Incorporated.
  7. Milbank Manufacturing Co.
  8. O-Z/Gedney; a brand of Emerson Industrial Automation.
  9. RACO; Hubbell.
  10. Spring City Electrical Manufacturing Company.
  11. Thomas & Betts Corporation; A Member of the ABB Group.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

- F. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- G. Gangable boxes are prohibited.
- H. Bell type boxes are prohibited. Type FS and FD device boxes shall be used.
- I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R or Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- J. Cabinets:
  - 1. NEMA 250, Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.

### PART 3 - EXECUTION

#### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC.
  - 2. Concealed Conduit, Aboveground: GRC.
  - 3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased.
  - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated.
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Loading dock.
    - b. Electrical equipment rooms.

- c. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
  - d. Mechanical rooms.
- 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 5. Damp or Wet Locations: GRC.
  - 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in and damp or wet locations.
  - 7. Feeders: GRC.
- C. Minimum Raceway Size: 3/4-inch trade size.
  - D. Raceway Fittings: Compatible with raceways and suitable for use and location.
    - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
    - 2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
    - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
  - E. Do not install aluminum conduits.
  - F. Install surface raceways only where indicated on Drawings.
  - G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12 inches of enclosures to which attached.
- H. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 8-foot intervals.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
  4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  5. Change from RNC, Type EPC-40-PVC to GRC before rising above floor.
- I. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways.
  2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- N. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
- O. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service raceway enters a building or structure.
  3. Where otherwise required by NFPA 70.
- P. Expansion-Joint Fittings:
1. Install in each run of aboveground RMC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Q. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- R. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
- S. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- T. Locate boxes so that cover or plate will not span different building finishes.
- U. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- V. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

### 3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

## SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

##### B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

#### 1.2 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

##### A. Wall Sleeves:

1. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- ##### B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

##### C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
  - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
  - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. **Advance Products & Systems, Inc.**
    - b. **CALPICO, Inc.**
    - c. **Metraflex Company (The).**
    - d. **Pipeline Seal and Insulator, Inc.**
    - e. **Proco Products, Inc.**
  2. **Sealing Elements:** Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. **Pressure Plates:** Stainless steel.
  4. **Connecting Bolts and Nuts:** Stainless steel of length required to secure pressure plates to sealing elements.

## 2.3 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.4 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
1. **Grade:** Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.



- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 260544

## SECTION 260923 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Indoor occupancy and vacancy sensors.
2. Switchbox-mounted occupancy and vacancy sensors
3. Existing Watt Stopper panels to be modified/replaced to comply with Michigan Energy code. Second floor lighting controls to be revised to include occupancy sensors, daylight harvesting and manual controls to comply with the Michigan Energy Code.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for the following:
  - a. Occupancy sensors.
  - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Field quality-control reports.
- C. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Software and firmware operational documentation.

## 1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
1. Warranty Period: [Two] <Insert number> year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 INDOOR OCCUPANCY AND VACANCY SENSORS

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Crestron
  - b. Eaton
  - c. Acuity Brands
  - d. Hubbell
  - e. Wattstopper
  - f. Delta Electronics (Americas) Ltd.
  
- B. General Requirements for Sensors:
  1. Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
  2. Dual technology.
  3. Separate power pack.
  4. Hardwired connection to switch.
  5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  6. Operation:
    - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    - c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  7. Sensor Output: Sensor is powered from the power pack.
  8. Power: Line voltage.
  9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  10. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.

- b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
  - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  12. Bypass Switch: Override the "on" function in case of sensor failure.
  13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.
- C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.
1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
  2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.
  4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet (110 square meters) when mounted 48 inches (1200 mm) above finished floor.
- D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
  2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).
  6. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet (110 square meters) when mounted 84 inches (2100 mm) above finished floor.
- E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of **1000 square feet (110 square meters)** when mounted **48 inches (1200 mm)** above finished floor.

## 2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Crestron, Eaton, Acuity Brands, Wattstopper
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, using hardwired connection.
  1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  3. Operating Ambient Conditions: Dry interior conditions, **32 to 120 deg F (0 to 49 deg C)**.
  4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V, and 800-W incandescent.
- C. Wall-Switch Sensor Tag WS1:
  1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of **900 sq. ft. (84 sq. m)**.
  2. Sensing Technology: Dual technology - PIR and ultrasonic.
  3. Switch Type: field-selectable automatic "on".
  4. Capable of controlling load in three-way application.
  5. Voltage: Dual voltage - 120 and 277 V.
  6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from **10 to 150 fc (108 to 1600 lux)**. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
  7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
  8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
  9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
  10. Color: As directed by the Architect.
  11. Faceplate: Color matched to switch.

## 2.3 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 22 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- D. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- E. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

### 3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's written instructions.
- C. Size conductors in accordance with lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.3 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."
- B. Label time switches and contactors with a unique designation.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 2 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
  - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
  - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
  - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

### 3.6 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

### 3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

#### 1.2 DEFINITIONS

- A. MCCB: Molded-case circuit breaker.  
B. SPD: Surge protective device.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.  
B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Panelboard schedules for installation in panelboards.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.



1.6 FIELD CONDITIONS

- A. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
  2. Altitude not exceeding 6600 feet.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. 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.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Flush and Surface-mounted, dead-front cabinets.
1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
  2. Height: 84 inches maximum.
  3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
  4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- F. Incoming Mains Location: Convertible between top and bottom.
- G. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

- H. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
  - 3. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.
  - 4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  - 5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- I. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- J. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- K. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

## 2.3 POWER PANELBOARDS

- 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. Eaton.
  - 2. General Electric Company; GE Energy Management - Electrical Distribution.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Lugs only.

- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.
- G. Branch Overcurrent Protective Devices: Fused switches.

#### 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. General Electric Company; GE Energy Management - Electrical Distribution.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Door in door with concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.
- G. SPD.
  - 1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
  - 2. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
    - a. Line to Neutral: 700 V for 208Y/120 V.
    - b. Line to Ground: 700 V for 208Y/120 V.
    - c. Neutral to Ground: 700 V for 208Y/120 V.
    - d. Line to Line: 1200 V for 208Y/120 V.
  - 3. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
    - a. Line to Neutral: 700 V.
    - b. Line to Ground: 700 V.
    - c. Neutral to Ground: 700 V.
    - d. Line to Line: 1200 V.
  - 4. SCCR: Equal to the SCCR of the panelboard in which installed.

5. Nominal Rating: 20 kA

## 2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton.
  2. General Electric Company; GE Energy Management - Electrical Distribution.
  3. Siemens Industry, Inc., Energy Management Division.
  4. Square D; by Schneider Electric.
- B. MCCB: Comply with UL 489, with series-connected rating to meet available fault currents.
  1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. Digital display of settings, trip targets, and indicated metering displays.
    - d. Multi-button keypad to access programmable functions and monitored data.
    - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    - f. Integral test jack for connection to portable test set or laptop computer.
    - g. Field-Adjustable Settings:
      - 1) Instantaneous trip.
      - 2) Long- and short-time pickup levels.
      - 3) Long and short time adjustments.
      - 4) Ground-fault pickup level, time delay, and I squared T response.
  4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
  6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
  7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  8. Subfeed Circuit Breakers: Vertically mounted.
  9. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Breaker handle indicates tripped status.
    - c. UL listed for reverse connection without restrictive line or load ratings.
    - d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.

- e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
  - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - g. Shunt Trip: 24-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
  - h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
  - i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."

## 2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

## 2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
  - B. Install panelboards and accessories according to NEMA PB 1.1.
  - C. Mount top of trim 90 inches above finished floor unless otherwise indicated.
  - D. Mount panelboard cabinet plumb and rigid without distortion of box.
  - E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
  - F. Install overcurrent protective devices and controllers not already factory installed.
- 1. Set field-adjustable, circuit-breaker trip ranges.

- G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- H. Install filler plates in unused spaces.
- I. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four empty conduits into raised floor space or below slab not on grade.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Standard-grade receptacles, 125 V, 20 A.
  2. GFCI receptacles, 125 V, 20 A.
  3. Toggle switches, 120/277 V, 20 A.
  4. Decorator-style devices, 20 A.
  5. Wall plates.

#### 1.2 ACTION SUBMITTALS

- A. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

#### 1.3 INFORMATIONAL SUBMITTALS

### PART 2 - PRODUCTS

#### 2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. Device Color:
1. Wiring Devices Connected to Normal Power System: Devices shall match those of the existing installation (black).
  2. Wiring Devices Connected to Essential Electrical System: Red .
  3. SPD Devices: Blue.
  4. Isolated-Ground Receptacles: As specified above, with orange triangle on face.
- F. Wall Plate Color: Shall be brushed stainless steel.
- G. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.



2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A :

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Pass & Seymour; Legrand North America, LLC.
  - b. Hubbell Wiring Devices
  - c. Leviton Manufacturing
  - d. Arrow Hart
2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A :

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Pass & Seymour; Legrand North America, LLC.
  - b. Hubbell Wiring Devices
  - c. Leviton Manufacturing
  - d. Arrow Hart
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A :

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Pass & Seymour; Legrand North America, LLC.
  - b. Hubbell Wiring Devices
  - c. Leviton Manufacturing
  - d. Arrow Hart
2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A :

1. **Manufacturers:** Subject to compliance with requirements, provide products by the following:
  - a. Pass & Seymour; Legrand North America, LLC.
  - b. Hubbell Wiring Devices
  - c. Leviton Manufacturing
  - d. Arrow Hart

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.4 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A :

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Pass & Seymour; Legrand North America, LLC
  - b. Hubbell Wiring Devices
  - c. Leviton Manufacturing
  - d. Arrow Hart
2. Standards: Comply with UL 20 and FS W-S-896.

B. Two-Pole Switches, 120/277 V, 20 A :

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Pass & Seymour; Legrand North America, LLC.
  - b. Hubbell Wiring Devices
  - c. Leviton Manufacturing
  - d. Arrow Hart
2. Comply with UL 20 and FS W-S-896.

C. Three-Way Switches, 120/277 V, 20 A :

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Pass & Seymour; Legrand North America, LLC.
  - b. Hubbell Wiring Devices
  - c. Leviton Manufacturing
  - d. Arrow Hart
2. Comply with UL 20 and FS W-S-896.

D. Lighted Single-Pole Switches, 120/277 V, 20 A :

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Pass & Seymour; Legrand North America, LLC.
  - b. Hubbell Wiring Devices
  - c. Leviton Manufacturing
  - d. Arrow Hart
2. Description: Handle illuminated when switch is on .
3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.5 DECORATOR-STYLE DEVICES, 20 A

A. Decorator Duplex Receptacles, 125 V, 20 A :

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Pass & Seymour; Legrand North America, LLC.
  - b. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Description: Two pole, three wire, and self-grounding. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.

B. Decorator Tamper-Resistant Duplex Receptacles, 125 V, 20 A :

1. **Manufacturers:** Subject to compliance with requirements, undefined:
  - a. Pass & Seymour; Legrand North America, LLC.
  - b. Hubbell Wiring Devices
  - c. Leviton Manufacturing
  - d. Arrow Hart
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Decorator Single-Pole Switches, 120/277 V, 20 A :

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Eaton (Wiring Devices - Arrow Hart).
  - b. Leviton Manufacturing Co., Inc.
  - c. Pass & Seymour; Legrand North America, LLC.
2. Comply with UL 20.

2.6 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: **0.035-inch**- thick, satin-finished, Type 302 stainless steel .
3. Material for Unfinished Spaces: Galvanized steel .
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant , die-cast aluminum with lockable cover.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 2. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 3. Install wiring devices after all wall preparation, including painting, is complete.
- C. Device Installation:
  - 1. Connect devices to branch circuits using pigtails that are not less than **6 inches** in length.
  - 2. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- D. Receptacle Orientation:
  - 1. Install ground pin of vertically mounted receptacles up , and on horizontally mounted receptacles to the right .
  - 2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.
- E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- F. Dimmers:
  - 1. Install dimmers within terms of their listing.
  - 2. Verify that dimmers used for fan-speed control are listed for that application.
  - 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

END OF SECTION 262726

## SECTION 265119 - LED INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

#### 1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, arranged by designation.
- B. Product Schedule: For luminaires and lamps, refer to lighting fixture schedule on the contract drawings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of luminaire.
- B. Sample warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

## 1.6 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 LUMINAIRE 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. CRI of 80. CCT of 3500 K typical for interior lighting.
- C. Rated lamp life of 50,000 hours.
- D. Internal driver.
- E. Nominal Operating Voltage: Refer to drawings and existing panels.

### 2.2 MATERIALS

- A. Metal Parts:
  - 1. Free of burrs and sharp corners and edges.
  - 2. Sheet metal components shall be steel unless otherwise indicated.
  - 3. Form and support to prevent warping and sagging
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers, and Globes:
  - 1. Prismatic acrylic
  - 2. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
  - 1. Housing and heat sink.
  - 2. White painted finish.

### 2.3 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

### 2.4 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports: Sized and rated for luminaire weight.
- E. Ceiling-Mounted Luminaire Support:
  - 1. Ceiling mount with pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
- F. Suspended Luminaire Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  - 3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- G. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- H. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 265119



## SECTION 265213 - EMERGENCY AND EXIT LIGHTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Emergency lighting units.
  - 2. Exit signs.
  - 3. Luminaire supports.

#### 1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with integral or remote emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.3 ACTION SUBMITTALS

- A. Shop Drawings: For nonstandard or custom luminaires.
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of luminaire.
- B. Sample Warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

## 1.5 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two year(s) from date of Substantial Completion.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

### 2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- 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. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for recessed luminaires.
- F. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.
  - 1. Emergency Connection: Operate one lamp(s) continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
  - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  - 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
    - b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
    - c. Humidity: More than 95 percent (condensing).
    - d. Altitude: Exceeding 3300 feet.
    - e. .

4. Test Push-Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
  - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
5. Battery: Sealed, maintenance-free, nickel-cadmium lead-acid type.
6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

## 2.3 EMERGENCY LIGHTING

- A. General Requirements for Emergency Lighting Units: Self-contained units.
- B. Emergency Luminaires:

1. **Manufacturers:** Subject to compliance with requirements, undefined:
  - a. Cooper Lighting.
  - b. Current Lightng.
  - c. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - d. LSI
2. Emergency Luminaires: as indicated on , with the following additional features:
  - a. Operating at nominal voltage of 120 V ac 277 V ac .
  - b. Internal emergency power unit.
  - c. Rated for installation in damp locations, and for sealed and gasketed fixtures in wet locations.
  - d. UL 94 5VA flame rating.

- C. Emergency Lighting Unit:

1. **Manufacturers:** Subject to compliance with requirements, undefined:
  - a. Cooper Lighting.
  - b. Current Lightng.
  - c. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - d. LSI
2. Emergency Lighting Unit: as indicated on Interior Luminaire Schedule Drawings.
3. Operating at nominal voltage of 120 V ac 277 V ac .
4. Wall with universal junction box adaptor.
5. UV stable thermoplastic housing , rated for damp locations.
6. Two LED lamp heads.
7. Internal emergency power unit.
8. External emergency power unit.

## 2.4 EXIT SIGNS

- A. Internally Lighted Signs:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Cooper Lighting.

- b. Current Lighting.
- c. Lithonia Lighting; Acuity Brands Lighting, Inc.
- d. LSI
2. Operating at nominal voltage of 120 V ac 277 V ac .
3. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
4. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

## 2.5 MATERIALS

### A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

### B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

### C. Diffusers and Globes:

1. Clear, UV-stabilized acrylic.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
4. Lens Thickness: At least **0.125 inch** minimum unless otherwise indicated.

### D. Housings:

1. Extruded aluminum housing and heat sink.
2. powder coat finish.

### E. Conduit: Rigid galvanized steel , minimum **3/4 inch** in diameter.

## 2.6 METAL FINISHES

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

## 2.7 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
  - 1. Sized and rated for luminaire and emergency power unit weight.
  - 2. Able to maintain luminaire position when testing emergency power unit.
  - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of fixture weight.
- E. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls .
  - 2. Do not attach fixtures directly to gypsum board.
- F. Suspended Luminaire Support:
  - 1. Pendants and Rods: Where longer than **48 inches**, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of fixture oscillations. Support outlet box vertically to building structure using approved devices.
  - 3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- G. Ceiling Grid Mounted Luminaires:
  - 1. Secure to any required outlet box.
  - 2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
- H. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

END OF SECTION 265213